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OFFICE OF EXPERIMENT STATIONS
W. O. ATWATER, DIRECTOR

EXPERIMENT STATION RECORD

VOLUME 1, SEPTEMBER, 1889-JULY, 1890

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE

WASHINGTON
GOVERNMENT PRINTING OFFICE
1890

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CONTENTS OF VOLUME I.

Page.

Introduction 1

Editorial notes:

The third annual convention of the Association of American Agricultural Colleges and Experiment Stations 57

Statistics of the stations in the United States 117

Statistics of the German agricultural experiment stations 175

Agricultural investigations in Canada 245

International Agricultural Congress at Vienna 246

Imperial College of Agriculture and Dendrology, Tokio, Japan 247

Suggestions as to investigations in dairying 247

Facts relating to new colleges and stations 248

Need of better methods of investigation 309

Concerning the character of station publications 310

Abstracts of Station Bulletins for 1889 3, 61, 120, 183, 249, 312

Abstracts of publications of the United States Department of Agriculture, 1889–90 103, 168, 235, 299

List of publications of the United States Department of Agriculture 50, 111, 171, 240, 303

List of station publications 52, 113, 172, 241, 304

Index of names 327

Index of subjects 331

O. E. S. 22

U. S. DEPARTMENT OF AGRICULTURE
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TABLE OF CONTENTS.

Page.
Letter of transmittal IX
Introduction 1
Abstracts of Station Bulletins, January–June, 1889, Part I 3–49

ALABAMA:

Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama 3
  Bulletin No. 3 (new series), January, 1889 3
    Report of agriculturist, J. S. Newman 3
      Experiment with corn 3
        fertilizers on ground-peas 3
        sweet potatoes 3
        fertilizers on turnips 3
      Comparison of varieties of turnips 4
      Varieties of grapes 4
    Report of chemist, N. T. Lupton, M. D., LL. D 4
    Report of botanist, P. H. Mell, M. E., Ph. D 4
      Woods of Alabama 4
    Meteorological report, P. H. Mell, M. E., Ph. D., and T. D. Samford, B. S 4
  Bulletin No. 4 (new series), February, 1889 5
    Strawberry, grape, and raspberry culture, J. S. Newman 5
  Bulletin No. 5 (new series), April, 1889 5
    Cotton, J. S. Newman 5
      Experiments with fertilizers 5
        Proper ratio between phosphoric acid and nitrogen in fertilizers for cotton 5
        Three forms of phosphoric acid for cotton 6
        Will lime increase the efficiency of the phosphates for cotton? 6
        Can improved methods and the use of fertilizers increase the profits of cotton culture on very poor, sandy lands? 6
      Varieties of cotton 7
      Study of the soils of the State with reference to cotton culture 7
    Feeding pigs for pork production 7
    Turnips 7
    Description of barns and dairy—feeding experiments, Isaac Ross 7
    Report of chemist, N. T. Lupton, M. D., LL. D 7
    Report of meteorologist, P. H. Mell, M. E., Ph. D 7
Canebrake Agricultural Experiment Station 8
  Bulletin No. 3, January, 1889 8
    Report of assistant director, W. H. Newman, M. Sc 8
      Experiments with corn 8
      Meteorology 8

Page.
ARKANSAS:
Arkansas Agricultural Experiment Stat. 8
Bulletin No. 8, April 19, 1889 8
Spaying of cattle 8
Bulletin No. 9, May, 1889 9
Cotton-seed hulls for fattening 9
Bulletin No. 10, June, 1889 9
Entomological notes, C. W. Woodworth, B. S 9
Meteorological summary 9
Chemical fertilizers 9
CALIFORNIA:
Agricultural Experiment Station of the University of California 10
Bulletin No. 82, June 15, 1889 10
The lakes of the San Joaquin Valley, E. W. Hilgard, Ph. D., LL. D 10
COLORADO:
Agricultural Experiment Station of Colorado 10
Bulletin No. 6, January, 1889 10
Notes on insects and insecticides, James Cassidy, B. S 10
Bulletin No. 7, April, 1889 13
Introduction, C. L. Ingersoll, M. S 13
Potatoes and sugar beets, James Cassidy, B. S., and D. O'Brine, D. Sc 13
Experiment with potatoes 13
Notes on the determination of starch in potatoes 13
Sugar beets 14
CONNECTICUT:
The Connecticut Agricultural Experiment Station 14
Bulletin No. 96, January, 1889 14
Feeding stuffs 15
Methods of valuation 15
Analyses 15
Average composition of feeds for dairy stock 15
Bulletin No. 97, April, 1889 15
Fungous diseases of plants, Roland Thaxter, Ph. D 15
Fertilizers 15
Duties of dealers in fertilizers 15
Gratuitous analyses of fertilizers 15
The trade values for 1889 15
Valuations 15
Analyses 15
Bulletin No. 98, June, 1889 16
Home-mixed fertilizers 16
Bulletin No. 99, June, 1889 17
Fertilizer analyses 17
Storrs School Agricultural Experiment Station 18
Bulletin No. 3, February, 1889 18
Roots of plants as manure 18
Meteorological observations 18
DAKOTA.
Dakota Agricultural Experiment Station 18
Bulletin No. 9, January, 1889 18
Experiments with corn, Luther Foster, M. Sc 18
Deep and shallow cultivation of corn 18
Bulletin No. 10, February, 1889 19
The germination of frosted grain, C. A. Keffer 19

Page.

DAKOTA—Continued.

Dakota Agricultural Experiment Station—Continued.

Bulletin No. 11, March, 1889 ... 19
Field experiments with wheat, oats, and barley, Luther Foster, M. Sc ... 19
Bulletin No. 12, April, 1889 ... 20
Forestry, C. A. Keffer ... 20
Trees on the college lawn ... 20
The forest-tree nursery ... 20
The evergreens ... 20
Bulletin No. 13, April, 1889 ... 21
Insects and insecticides, I. H. Orcutt, M. D., Ph. D ... 21
Bulletin No. 14, April, 1889 ... 22
The sugar beet, J. H. Shepard, M. S ... 22

DELAWARE.

The Delaware College Agricultural Experiment Station ... 22
Bulletin No. 4, May, 1889 ... 22
Injurious insects, identification and extermination, M. H. Beckwith ... 22
Bulletin No. 5, June, 1889 ... 22
The inspection of seed and of stock feed in Delaware, A. T. Neale, Ph. D ... 22
Seed testing, F. D. Chester, M. S ... 23
Impurities ... 23
Dodder ... 24
Germination tests ... 25

FLORIDA.

Agricultural Experiment Station of Florida ... 25
Bulletin No. 5, April, 1889 ... 25
Analysis of fertilizers, J. M. Pickell, Ph. D., and J. J. Earle, A. B. ... 25

GEORGIA.

Georgia Agricultural Experiment Station ... 26
Bulletin No. 2, January, 1889 ... 26
Factors in agricultural investigations, W. L. Jones, M. D ... 26
Ash analyses of native woods, H. C. White, Ph. D ... 26
Origin of soils geologically considered, J. W. Spencer, Ph. D ... 26
The imported cabbage butterfly (*Pieris rapæ*), J. P. Campbell, Ph. D ... 26
Field experiments with phosphates and kainit applied to cotton, W. L. Jones, M. D ... 26
Summary of meteorological observations ... 27
Preservation of the sweet potato in winter, W. L. Jones, M. D ... 27
Bulletin No. 3, April, 1889 ... 27
Entomology, J. P. Campbell, Ph. D ... 27
Additional ash analyses of native woods, H. C. White, Ph. D ... 27
Cow-pea as a fertilizing crop, manures for, W. L. Jones, M. D ... 27
Preservation of the sweet potato in winter, W. L. Jones, M. D ... 27

ILLINOIS.

Agricultural Experiment Station of the University of Illinois ... 28
Bulletin No. 4, February, 1889 ... 28
Field experiments with corn, G. E. Morrow, A. M., and T. F. Hunt, S. B ... 28
Testing of varieties ... 28
Test of varieties for ensilage ... 29
Time of planting ... 29
Depth of planting ... 30

Page.

ILLINOIS—Continued.

- Agricultural Experiment Station of University of Illinois—Cont'd.
  - Bulletin No. 4, February, 1889—Continued.
    - Field experiments with corn, etc.—Continued.

      - Thickness of planting 30
      - Planting in hills or drills 31
      - Frequency of cultivation 31
      - Depth of cultivation 31
      - Effect of root pruning 31
      - Root growth 32
      - Effect of fertilizers 32
      - Comparison of fertilizers used with corn 32
      - General conclusions and suggestions 33
    - Garden experiments with sweet corn, 1888, T. J. Burrill, Ph. D., and G. W. McCluer, S. B 33
  - Bulletin No. 5, May, 1889 34
    - Grasses and clovers, effect of ripeness on yield and composition, T. F. Hunt, S. B 34

INDIANA.

- Agricultural Experiment Station of Indiana 35
  - Bulletin No. 18, January, 1889 35
    - Experiments with vegetables and commercial fertilizers, James Troop, M. S 35
      - Commercial fertilizers on potatoes 35
      - Varieties of sweet corn, onions, and peas 35
      - Varieties of sugar beets 36
      - Japanese vegetables 36
  - Bulletin No. 19, January, 1889 36
    - The botanical department 36
    - Spotting of peaches and cucumbers, J. C. Arthur, D. Sc 36
  - Bulletin No. 20, January, 1889 36
    - Experiments in floriculture, P. Van Landeghem 36
      - Cross-fertilization of chrysanthemums 36
      - Culture of tropical ferns 37
  - Bulletin No. 21, February, 1889 37
    - Rational feeding, C. A. Wulff, M. S 37
  - Bulletin No. 22, March, 1889 37
    - Commercial fertilizers, H. A. Huston, A. C 37
  - Bulletin No. 23 37
    - Experiments with corn in 1888, W. C. Latta, M. S 37
      - Early and late planting 38
      - Deep and shallow plowing 38
      - Deep, medium, and shallow culture 38
      - Use of different corn-cultivators 38
      - Different rates of planting 38
      - Effect of previous manuring 39
      - Comparison of varieties of corn 39
  - Bulletin No. 24, May, 1889 40
    - Experiments on milk production, C. A. Wulff, M. S 40
      - Cold *vs.* warm water for milch cows 40
      - Divided milkings 40
      - Microscopical examinations 40
      - Studies on milk-secretion 41
  - Bulletin No. 25, June, 1889 41
    - Introduction, H. E. Stockbridge, Ph. D 41
    - Entomological experiments, F. M. Webster 41

Page.

IOWA.

Iowa Agricultural Experiment Station 42
Bulletin No. 4, February, 1889 42
Wild plums, R. P. Speer 42
A chemical study of apple twigs, G. E. Patrick, M. Sc 42
An investigation of apple twigs, B. D. Halsted, D. Sc 43
Propagation of trees and shrubs from cuttings, J. Craig 44
Some suggestions concerning the corn root-worm, Prof. H. Osborn. 44
Bulletin No. 5, May, 1889 44
Sorghum, G. E. Patrick, M. Sc 44
Important injurious insects, C. P. Gillette, M. Sc 45
Experiments with pyrethum 45

KANSAS.

Kansas Agricultural Experiment Station 46
Bulletin No. 6, June, 1889 46
Silos and silage, E. M. Shelton, M. Sc 46

List of publications of the U. S. Department of Agriculture, January 1 to August 15, 1889 50
List of station bulletins, January 1 to August 15, 1889 52

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., September 2, 1889.

Sir: In accordance with the acts of Congress and the directions of the Secretary of Agriculture in conformity therewith, it is the duty of this office not only to indicate lines of inquiry and furnish such advice and assistance as will best promote the objects for which the agricultural experiment stations are established, but also to "compare, edit, and publish such results" of their work as may be deemed necessary.

There is a very general demand for brief accounts of the current work of the experiment stations and kindred institutions in this country. To make such a current record more serviceable it should be published regularly and as promptly as practicable.

I have the honor to transmit the first number of a publication entitled Experiment Station Record, which is an attempt in this direction. Its principal contents are abstracts of bulletins and a list of publications of the experiment stations and of this Department received at this office from January 1 to August 15 of this calendar year.

Respectfully,

W. O. Atwater,
Director.

Hon. J. M. Rusk,
Secretary of Agriculture.

EXPERIMENT STATION RECORD.

Vol. 1. SEPTEMBER, 1889. No. 1.

INTRODUCTION.

In pursuance of the plan announced in the introduction to Part I of the Digest of Annual Reports of the Agricultural Experiment Stations in the United States for 1888 (Experiment Station Bulletin No. 2), the publication of abstracts of station bulletins of the current year is here begun.

The Digest of Reports for 1888 is intended to include such outlines and details of the station work as will be most useful for permanent record and convenient reference. It will give a fair idea of the condition of the experiment station enterprise in the United States in that year. The aim here is simply to make a current record, in brief outline, of the results of experiment station and kindred work. The effort has been to give such a rapid and concise synopsis of the contents of bulletins as will enable the busy worker to readily ascertain what is going on at the stations in various lines. It has not been practicable, however, to adhere strictly to this plan. Aside from those difficulties inherent in every new enterprise of the kind, the main embarrassment has arisen from the diverse character of the material in the bulletins. These vary from brief, popular summaries of the results of investigations at the stations and elsewhere to detailed accounts of elaborate experiments. To include within narrow limits anything like a consistent exhibit of bulletins so widely different in scope and method of treatment is well nigh impossible. Naturally, therefore, certain bulletins containing much valuable work have received scant notice here. It is hoped that serious omissions may be supplied in a more detailed digest of station work for 1889. It may be added, however, that without regard to the perplexities imposed on this office, as here indicated, it seems not improbable that the stations will be gradually forced, by circumstances peculiar to themselves, to distinguish between the small and numerous bulletins, issued in large editions for the information of practical farmers, and those full and accurate reports of experiments, with which alone the demands of the scientist can be satisfied, and which are to be stored in libraries as the permanent evidence of the industry and success of the investigators.

Besides the abstracts of station literature, it is proposed to include in the Experiment Station Record brief accounts of the publications and work of this Department and such information for station workers and others interested in agricultural science as may from time to time be deemed advisable. In this number will be found a list of the publications of the Department from January 1 to August 15, 1889, as well as a list of station bulletins received at this office during the same period.

The Experiment Station Record will, if the present plan is carried out, be issued in numbers to be paged continuously and form a volume of six or more numbers for each year. Indexes of names and subjects will be published for each volume.

The publications of the Office of Experiment Stations, issued and planned for, are divided into six classes:

1. *Experiment Station Record.*—A current record of the work of experiment stations and the Department of Agriculture, and topics of kindred interest.
2. *Experiment Station Bulletins.*—These contain fuller accounts of matters of importance to station workers and others especially interested in agricultural science.
3. *Farmers' Bulletins*—Short, clear, and practical statements of the results of experiments at the stations and elsewhere. These will be issued in large editions for general distribution.
4. *Miscellaneous Bulletins.*—These treat of a variety of subjects more or less closely connected with agricultural science.
5. *Monographs.*—These are planned to treat of special topics in agricultural science, in considerable detail, and are intended for reference and for the use of specialists.
6. *Circulars.*—These are brief, frequently intended as letters, and, as a rule, of transient importance. They are issued in very limited numbers for restricted circulation.

As most of the publications of the office are printed in comparatively small editions, it is very desirable that persons making requests for them should state specifically which publications they desire. While the Department wishes its publications to be widely distributed, it is equally desirous that none of them shall be wasted. *Applicants are requested to ask for only what they wish to use.* Except in special cases, the office can not undertake to supply full sets of its publications. Circulars, in particular, will be sent only to those for whom they are specially intended. A list of publications already issued is given on page 50.

ABSTRACTS OF BULLETINS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES FROM JANUARY TO JUNE, 1889.

PART 1.

ALABAMA.

Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama.

Department of the Agricultural and Mechanical College of Alabama.
Location, Auburn. Director, J. S. Newman.

BULLETIN NO. 3 (NEW SERIES), JANUARY, 1889.

REPORT OF AGRICULTURIST, J. S. NEWMAN (pp. 3–10.)

Experiment with corn (pp. 3, 4).—"The object of this experiment was to inquire if corn could be grown profitably upon land which chemical analysis classes as practically sterile." The soil is a sandy drift with no clay within 3 feet of the surface. When the Station took charge of it, it had been "worn out" and had grown up to stunted pines and broom sedge. The season was very unfavorable. The chemical analysis of the soil is given, and the product of 10 acres fertilized with compost of cotton-seed, stable manure, and English superphosphate (1,000 pounds per acre) is compared with that of one acre of unfertilized soil of the same quality. The net profit on the fertilized land was $5.56 per acre, on the unfertilized $2.49.

Experiment with fertilizers on ground peas (p. 4).—This was undertaken with the hope of discovering a remedy for the tendency of this crop to produce faulty pods (pops) on sandy soil. Lime, superphosphates, kainit, cotton-seed meal, singly and in combination, and compost were used. Air-slaked lime gave the largest per cent of good peas, and "complete" fertilizers gave the smallest.

Experiment with sweet potatoes (p. 5).—To compare the effects of different fertilizers. Results are given in tabular form.

Fertilizers for turnips (pp. 5–7).—Trials were made with the Norfolk variety of turnips on twenty-two plats. Superphosphate, raw phosphate, kainit, sulphate of ammonia, cotton-seed meal, and cotton-seed-hull ash, singly and in various combinations, and cow and horse manure were used on different plats. The effects of planting the turnips 6 inches, 1 foot, and 2 feet apart in the drill were also tested. The variations in the duplicate unmanured plats were wide. The fertilized plats were not duplicated. The results are stated in tabular form.

Taking the yields as actually obtained on the single plats, kainit brought a larger yield than any other single substance, while phosphates, which are frequently regarded as a specific for turnips, seemingly increased the yield but little. There was little apparent difference in effect between raw phosphate and superphosphate. Cow and horse manure did not bring yields which compared favorably with those produced by one-twentieth the weight of artificial fertilizers. One foot seemed the most advantageous distance between plants.

Comparison of varieties of turnips (pp. 7, 8).—"Twenty-five varieties of turnips were planted August 23 upon thin, sandy land, well manured broadcast with compost, cotton-seed meal, and cotton-seed-hull ash." Earliest Bloomsdale Red Top was the earliest of the twenty-five varieties; Milan Strap-leaf, second; Early Flat Dutch Strap-leaf, third; Purple Top Strap-leaf, fourth; and Large Early Red Top Globe, fifth. White Globe and White Globe Strap-leaf seemed to be identical. Details are given in tabular form.

Varieties of grapes (pp. 9, 10).—Notes on thirty-nine varieties. As stated in the article, the observations must be continued through a series of years to be valuable and reliable. Paper bags were used with considerable success and profit to protect the grapes from "black rot," insects ,and birds. "It cost $1 to protect 500 pounds, or 1,000 bunches, of grapes."

REPORT OF CHEMIST, N. T. LUPTON, M. D., LL. D. (pp. 11–13).—This contains tables of analyses of thirty-seven samples of commercial fertilizers received from the State Commissioner of Agriculture, six soils and subsoils, and two specimens of coal.

REPORT OF BOTANIST, P. H. MELL, M. E., PH. D. (pp. 14–17).—This article contains notes on the *Woods of Alabama*, continued from Bulletin No. 2. Attention is called to the fact that Black Walnut (*Juglans nigra* L.) is "rapidly disappearing from the State because of the great number of trees annually cut for lumber." The people are urged to plant trees annually to repair the loss. The chestnut trees in Alabama "seem to be subjected to a blight or some destructive disease that is rapidly destroying them. This is particularly true when other trees are cut from around them."

METEOROLOGICAL REPORT, P. H. MELL, M. E., PH. D., AND T. D. SAMFORD, B. S. (pp. 18–22).—This article contains an account of the observations made with soil thermometers and other instruments during October, November, and December, 1888. The Station has thirty soil thermometers, divided into three sets, ranging in depth from 1 to 96 inches.

Two of these sets of soil thermometers are placed on the top of a hill which is exposed to the constant sweep of the winds and the full strength of the sun's rays. The third set is located in bottom land, on the banks of a running stream. This set is more or less shaded by a rank growth of vegetation. Over each instrument is placed a box perforated with holes to allow a free circulation of air, and at the same time to exclude the heat rays of the sun. The soil is sandy and is well drained.

From the data afforded by these instruments the following conclusions may be drawn. During the summer months the upper layers of the soil are 10 to 15 degrees warmer than the atmosphere, but become cooler with depth, and in July a depth of 5 feet below the surface shows a temperature 10 degrees cooler than the upper layer. In the fall and winter the reverse of this is true; that while the upper layers of the soil are still somewhat warmer than the atmosphere, yet the lower layers increase in warmth, proportionally so with depth. For instance, the month of July shows a temperature, at the depth of 96 inches below the surface, 11 degrees cooler than the air; while December shows a temperature at the same depth nearly 15 degrees warmer than that of the air.

It is also observed that while the range of temperature of the atmosphere fluctuates considerably, that of the soil is more constant; and further, that the daily range steadily decreases for 24 inches, below which depth it is practically nothing—seldom being greater than a half of a degree, and from the figures in the table it will be seen that the daily range of temperature is several degrees less in the bottom than it is on the hill; showing the effects of location of land, moisture in soil, and the effects of evaporation caused by the sweep of the winds—the bottom being greatly protected from this agent.

Again, it will be seen that there is but little difference in the temperature of the bottom land and upland during the fall months. During the hot summer the bottom is a little cooler; during the winter it is a little warmer than the upland, and whenever the temperature is about 40 degrees and below, then the bottom land is several degrees warmer than the upland.

BULLETIN NO. 4 (NEW SERIES), FEBRUARY, 1889.

STRAWBERRY, GRAPE, AND RASPBERRY CULTURE, J. S. NEWMAN (pp. 3–12).—The bulletin contains practical directions for the cultivation of strawberries, grapes, and raspberries, written "in response to numerous inquiries from those who have been induced by the work of this Station to begin fruit culture, and for the purpose of instructing local experimenters who receive plants from this Station for experimental purposes."

BULLETIN NO. 5 (NEW SERIES), APRIL, 1889.

COTTON, J. S. NEWMAN (pp. 3–28).

Experiments with fertilizers (pp. 3–13).—The object of these experiments was—

> to inquire how much reserve force remained from previous applications of commercial manures to sandy soil which has no retentive clay within 3 feet of the surface. Cotton was planted in 1888, *without manure*, upon plats to which different elements and combinations of elements of plant food had been applied in 1886 and 1887.

As indicated below, several questions were studied, each by a series of trials. The results of each series are stated in tabular form.

Proper ratio between phosphoric acid and nitrogen in fertilizers for cotton.—In this experiment the quantities of phosphoric acid and potash are constant, while the nitrogen varies so as to give the following ratios between the nitrogen and phosphoric acid from the two sources, dried blood and cotton-seed meal: Nitrogen 1 pound to phosphoric acid 1, 2, 4, 6 and 8 pounds.

The smaller quantity of nitrogen applied seemed to furnish as much as the plant, with its environments, could take up, and the plant seemed indifferent as to the sources from which it derived it. There seemed to be a certain degree of cumulative force in 1887, which was lost by failure to renew by additional applications in 1888. The quantity of nitrogen applied seems not to have affected the relations between the weight of seed and that of the lint.

Three forms of phosphoric acid.—Soluble phosphoric acid in English superphosphate, reduced (citrate soluble) in reduced phosphate, and insoluble (acid soluble) in floats, were used separately and in combination with cotton-seed meal or air-slaked lime. Eight plats were manured and one left unmanured. In 1886 the effect of each of the three forms of phosphoric acid was tested on duplicate plats side by side. The yield of the duplicates varied widely in each case; in some cases the differences were larger than between plats with different fertilizers.

In 1886 each of the forms of phosphoric acid was applied to two adjacent plats without nitrogen. In 1887 the same quantities of the phosphoric acid in the three forms * * * were applied each to one plat, and nitrogen in cotton-seed meal to each of the other plats. In 1888 all of the plats were planted without manure. These results indicate very little leaching of the phosphoric acid and a cumulative effect of the floats. The results in 1888, without additional application, uniformly exceed those of 1886, when the phosphates were first applied; and in No. 1, to which only floats have been applied, they yielded more as the effect of the reserve force than in either previous year.

Will lime increase the efficiency of the phosphates?—Air-slaked lime was mixed in the drill with floats and with acid phosphate, and the yields of cotton compared with those produced when the floats and acid phosphates were used without the lime. The experiment was begun in 1886, repeated in 1887, and again, but without manure, in 1888. The results were inconclusive. Trials with floats, combined with nitrogenous fertilizers, and with floats and acid phosphate in combination with nitrogen and potash in different forms, are included in the experiment.

Can improved methods and the use of fertilizers increase the profits of cotton culture upon very poor, sandy lands?—The experiments reported were made on 10 acres of very poor sandy soils, taken without regard to topography of the land or the quality of the soil.

The soils were thoroughly prepared, well fertilized, and carefully cultivated. The fertilizers applied were 1,000 pounds of compost of cotton-seed, stable manure, and phosphate, and 200 pounds of cotton-seed meal and acid phosphate, equal parts of each per acre, at a cost of $7 per acre. These were applied in the drill. One acre, of the same average quality as the 10 and adjoining the latter, was planted without manure for comparison. The cotton on the 10 acres grew off beautifully, but in consequence of heavy leaching rains upon the coarse, deep sand it began to blight in June, and was dead upon 9 acres early in August. About 1 acre lying near a branch continued to fruit until September.

An examination of the statements [which are given in tabular form] will reveal the fact that the difference in value over cost of production per acre on manured and unmanured land is $5.96, which is attributable to the use of the manure, which costs $7 per acre, just three times the usual cost, and yet we find here the increase resulting from the use of the manure pays 85 per cent profit upon its cost.

Varieties of cotton (pp. 14–16).—A brief account of an experiment with eleven varieties of cotton.

Study of the soils of the State (pp. 16–28).

For the purpose of studying the needs of the various typical soils of the State, a dozen sacks of the soil and subsoil from localities representing large areas of the State were collected and subjected to chemical and plant analysis. Samples of both soil and subsoil were furnished the chemist, the analyses of which will be found in the report of Dr. N. T. Lupton, chemist, in this bulletin. Bins were prepared 18 inches broad and wide and 12 inches deep, eight for each soil. In these the subsoil was first deposited, and the box then filled with soil, thus restoring somewhat the natural conditions. Different elements and combinations of elements of plant food were applied to seven of these bins, the eight receiving nothing, as shown in the tabular statements appended. A cotton plant was grown in each bin and careful observations made of their development and production. * * * The results show very marked differences in the effect of the manures, and valuable suggestions are made by them, but conclusions should not be drawn from a single experiment.

The details of the experiment are given in tabular form. Especial attention is called to the effects of "Thomas scoria" (basic slag).

FEEDING PIGS FOR PORK PRODUCTION (pp. 29–31).

Six Essex pigs, twelve to fourteen months old, that had grown fat upon field peas, ground peas, and sweet potatoes, gleaned from the fields, were put into separate pens on the 17th of December, 1888, and each given as much corn as he would eat as a preparatory period to detect individual peculiarities, and to learn accurately the producing power of whole corn fed wet. The pigs were already fat enough when put up, and by the second period, in which each was fed differently, as shown in the accompanying tabulated statement, were excessively fat. This being true, their capacity for laying on additional fat was reduced. The gradually diminishing ratio of increase from the first to the last period indicates that the profits of feeding diminish with increased fatness. * * * The condition of the pigs, when fed upon these products, renders [necessary] a repetition of the experiment upon pigs not so far advanced in fatness.

The details of the experiment are given in tabular form.

TURNIPS (p. 32).—Notes showing the relative keeping qualities of twenty-five varieties.

DESCRIPTION OF BARNS AND DAIRY—FEEDING EXPERIMENTS, ISAAC ROSS (pp. 33–38).—This article contains a brief description of the barns, dairy, live stock, etc., of the Station, and an account of a short feeding experiment with three cows.

REPORT OF CHEMIST, N. T. LUPTON, M. D., LL. D. (pp. 30–35).—Analyses of commercial fertilizers, feeding stuffs, dairy products, air-dried soils and subsoils of the State, and miscellaneous substances are reported for January, February, and March, 1889.

REPORT OF METEOROLOGIST, P. H. MELL, M. E., Ph. D. (p. 56), for January, February, and March, 1889.

Canebrake Agricultural Experiment Station.

Department of Agricultural and Mechanical College of Alabama.
Location, Uniontown. Director, J. S. Newman.

BULLETIN NO. 3, JANUARY, 1889.

REPORT OF ASSISTANT DIRECTOR, W. H. NEWMAN, M. Sc. (pp. 3–11).
Experiments with corn (pp. 3–7).

Parallel experiments were conducted upon black slough bottom and the prairie land known as "shell ridge," for the purpose of ascertaining what fertilizers, if any, will pay upon these varieties of prairie soil. The results give little promise of profit from the use of fertilizers of any character. The effects of drainage are somewhat more encouraging, but expectations have not been realized.

The details of the experiments are stated in tables.

Meteorology (pp. 8–11).—Tables are given showing the observations with soil thermometers, the temperature of the air, rain-fall, etc., for August–December, 1888. To determine the relation between rain-fall and drainage, measurements of the outflow from a system of tile drains laid 30 feet apart and 3 feet deep, over 3 acres, were made for six consecutive days in October, 1888.

The rain-fall was as follows: October 22, .97 inch; 23d, .55; 24th, .69, and 25th, 1.49, making a total precipitation of 3.70 inches in four days. The total precipitation upon the 3 acres in the four days was 305,148 gallons, and the outflow *during six days*, from October 24 to 29 inclusive, was 208,353 gallons, or 68 per cent of the precipitation. This, of course, does not cover the whole outflow, but simply indicates the promptness with which the tile withdraws the surplus water from the first 3 feet of the surface, even in such tenacious soils as that of the canebrake. No measurements were made on the first two days of the precipitation. That much of the surplus occasioned by these had already been withdrawn when the measurements commenced is shown by the fact that the first measurement on the 24th showed an outflow of 1 gallon to eight seconds. That there was still much surplus water in the soil was indicated by the outflow of 1 gallon to ninety seconds the seventh day. An outflow of 7,200 gallons from 3 acres of land in one hour, or 172,800 in one day, indicates the importance of drainage.

ARKANSAS.

Arkansas Agricultural Experiment Station.

Department of Arkansas Industrial University.
Location, Fayetteville. Director, A. E. Menke, D. Sc.

BULLETIN NO. 8, APRIL 19, 1889.

SPAYING OF CATTLE (pp. 3–11).—Experiments were performed on a number of cattle of common stock from six months to eight or ten years old. The best results were obtained with those under one year old.

From our observations on these and other animals, we conclude that spaying should not be undertaken on pregnant cows, nor is it likely to be of much benefit to very old animals, or such as from their general appearance have weak powers of digestion. Spaying will not convert a poor milker into a good milker, nor will it do away with the bad points which characterize the lank, unthrifty animal; but performed upon ordinary stock, selected according to the indications previously given, it will be found profitable both by hastening maturity and by enhancing the marketable value of the flesh.

BULLETIN NO. 9, MAY, 1889.

COTTON-SEED HULLS FOR FATTENING (pp. 3–15).—This is a preliminary record of experiments in this important line. A ton of seed yields 900 pounds of hulls, which until recently has been used for fuel at the cotton-seed oil mills. Noticing that cattle in the neighborhood of one of these mills were subsisting on the hulls, some private parties have undertaken feeding experiments with them on a somewhat extensive scale.

The following is a succinct account of the methods adopted:

After coming off the cars the cattle are put in open yards for some time (about thirty days), to become accustomed to feeding and to recover from the fever of shipment, which is always present, especially in those brought from Texas. This condition is accompanied by high-colored urine. It does not prove serious.

The diet at the start is 4 pounds of meal and about 23 pounds of hulls. The regular ration later is 8 pounds meal and 25 pounds hulls per diem; this is fed half in the morning and half in the evening. Hay is given once a week; if manure becomes abnormally soft, the hay is increased. A constant supply of fresh well water raised by steam pumps is on hand. The water-troughs are frequently cleaned of algæ which collect on the bottom and sides. Salt is always accessible. The period of feeding is about four months. About 1 per cent of the cattle scour, but there is no fatality from this cause. It is attributted to the meal and not the hulls.

Scouring cattle are treated by turning out of the sheds into the yard; they are given hay and less meal but the ordinary ration of hulls is continued; perfectly fresh water is supplied. The duration of scouring is one or two days. Some animals may continue quite loose in the bowels and yet gain in weight. There is no recurrence of the diarrhea.

The cattle are released and turned into the open yards for a week or more before shipment, and fed the same rations as before, in troughs. They generally under these circumstances feed at night and lie during the day. Cattle are weighed on arrival and departure. None are fed during the summer months. They sell in Chicago for full price of Texas fed cattle of the best grade and they can pass for corn-feed steers.

This Station has begun a series of experiments on the same plan with two steers and two heifers. Details of the progress of this experiment are reported and the chemical composition of the cotton-seed hulls is given.

BULLETIN NO. 10, JUNE, 1889.

ENTOMOLOGICAL NOTES, C. W. WOODWORTH, B. S. (pp. 3–18).—This article contains directions for the use of kerosene as an insecticide and a compiled account of the tarnished plant bug (*Lygus pratensis L.*).

METEOROLOGICAL SUMMARY FOR THREE MONTHS ENDING MAY 31, 1889, (p. 18).

CHEMICAL FERTILIZERS (pp. 18–26).—This contains general statements regarding commercial fertilizers, trade values, analyses of seventeen fertilizers, directions for sampling fertilizers and the full text of the State law regulating the sale of commercial fertilizers.

CALIFORNIA.

Agricultural Experiment Station of the University of California.

Department of the University of California.
Location, Berkeley. Director, E. W. Hilgard, Ph. D., LL. D.

BULLETIN No. 82, JUNE 15, 1889.

THE LAKES OF THE SAN JOAQUIN VALLEY, E. W. HILGARD, PH. D., LL. D. (pp. 1–4).—This gives an interesting account of investigations with reference to the contraction of the lakes of the upper San Joaquin Valley by evaporation and the consequent effects upon animal life, and the use of these waters for irrigation. The problem of reclaiming the alkaline soils laid bare by the recession of the waters is also considered. This bulletin deals especially with Lake Tulare, and is issued in advance of a general report on the subject in order to secure, if possible, more light upon the history of these lakes before any definite conclusions are drawn.

The question as to whether Lake Tulare shall be utilized in the future as an irrigation reservoir or drained and its bed used for agricultural purposes is touched upon. The original area of the lake was over a thousand square miles, and the territory directly affected by the general question discussed in the bulletin is more than 6,000 square miles in area. (See monograph on The Physico-geographical and Agricultural Features of California, by E. W. Hilgard, U. S. Census of 1880, Vol. VI, p. 681.)

COLORADO.

Agricultural Experiment Station of Colorado.

Department of the State Agricultural College.
Location, Fort Collins. Director, Charles L. Ingersoll, M. S.

BULLETIN No. 6, JANUARY, 1889.

NOTES ON INSECTS AND INSECTICIDES, JAMES CASSIDY, B. S. (pp. 2–20).

The following insects comparatively new to Colorado were observed in 1888: The garden web-worm (*Eurycreon rantalis*); the squash bug (*Coreus tristis*); and the false chinch bug (*Nysius angustatus*).

We took the first specimen of *Pieris rapae* for this season on March 17; *Pieris protodice* was flying at this time, and also one of the "skippers" (*Eudamus tityrus*); *Vanessa antiopa* and *V. milberti* were seen in numbers March 7.

The codling moth (*Carpocapsa pomonella*) was plentiful toward the end of the month of April, but the hackberry butterflies and white-lined morning sphinx moth, so plentiful last season, almost disappeared this year.

Some species of genus *Grapta* were as early and as numerous as ever. The imported currant borer (new here) appeared in force May 26.

The apple-leaf beetle appeared May 7, and toward the latter part of the month attacked the foliage of the grape.

The moths of the garden web-worm appeared early in April and the false chinch bug and squash bug the first week in June.

The parsnip butterfly was a common species in the plains region throughout the State, and, to some extent, in the mountains late in May. The tomato worm appeared June 1, feeding on the tomato and tobacco, in particular.

Practical directions are given for the use of various insecticides.

Notes on insects (pp. 8–20).

Currant measuring worm (*Eufitchia ribearia*).—This caterpillar defoliated a large planting of the Houghton gooseberry, leaving untouched the Downing.

European cabbage caterpillar (*Pieris rapæ*).—This insect was very common this season over a large portion of Colorado, hovering over the cabbages in vast numbers. Our first specimens appeared early in March, and toward midsummer it was one of our most common species. *Remedies:* On July 15, and on the 26th of the same month, we made separate trials of the kerosene emulsion and Ongarth's liquid tree protector with success against cabbage worms. The latter was particularly effective, the worms dying whenever struck by the liquid.

Squash bug (*Coreus tristis*).—This well-known insect appeared in this region in numbers for the first time this season, and proved a serious drawback to the culture of the squash and pumpkin. *Remedies:* The kerosene emulsion and Ongarth's liquid tree protector kept them in subjection.

Codling moth (*Carpocapsa pomonella*).—The larva of this moth is the chief pest of our apple orchards in Colorado, as elsewhere. *Remedies:* We applied London purple April 28, and again twelve days later, in the proportion of 1 pound of the purple to 100 gallons of water, using the Field force-pump and tank mounted on the platform of a two-wheeled cart. Every alternate tree in a row of Duchess of Oldenburg was thus treated. This was too strong, as it hurt the foliage considerably. * * * A similar application of Paris green in the same proportion was made in another orchard April 28 and May 10. This proved to be satisfactory; the foliage was uninjured, and but few apples affected by the codling moth were found. Careful analysis of the calyx of the fruit was made by Dr. O'Brine, chemist of the Station, and no trace of arsenic was found—the usual winds and rains of the season secured its dispersion. The time to make the first application is as soon as the fruit is formed and while erect on its stem.

Another good effect of the application of the arsenites at this season is the destruction of all other leaf-eating larvæ, some of which are so injurious to the apple tree in this region during the months of April and May. It is a great gain to fruit-growers in this dry region to know that the arsenites may be safely applied to the foliage of the apple tree without danger to human life when the fruit is fit for table use.

Apple-leaf beetle (*Graptodera foliacea*).—This brassy-green apple insect has been injurious to the foliage of apple grafts and small apple trees for several years in Colorado. It confines its work, however, mainly to the nursery, never working high above the surface of the ground. It does not touch the pear, although working in numbers on apple grafts, on either side of them. It shows, with us, a partiality for some varieties over others, and is sometimes as destructive to the grape as to the apple. It is a pest in every valley in the State where the apple is grown. It also feeds in great abundance on the native species of the genus *Gaura*, so plentiful in this region. *Remedies:* Fortunately it is easily overcome. We have to contend with it annually, and find no difficulty in getting rid of it with the arsenical preparation already noted.

Eight-spotted forester (*Alypia octomaculata*).—The larva of this beautiful moth attacks the foliage of the grape annually, in some sections of the State, in large numbers. There are two broods, the first moths appearing in May, and the second in August. *Remedies:* I have always succeeded in destroying the larvæ of the first brood with a weak application of Paris green in water, in June. For the second brood, if the vines are in bearing, it will not do to apply the poison, but if the first attack has been promptly met, there will not be much trouble from the second.

Imported currant borer (*Ægeria tipuliformis*).—For a few years past the larva of this moth has been injurious to the red currant bush in this State, appearing in this region from the middle to the last of the month of May.

Garden web-worm (*Eurycreon rantalis*).—The most remarkable insect visitation of the year to Colorado was the presence of this insect. The moths appeared in immense numbers late in April, covering the plains and reaching well up into the mountains, and embracing the greater portion of the State. * * * The first larvæ were noticed May 29 (then quite small); from this date to July 15, larvæ of all sizes were working together, and were injurious as late as July 4. The cocoons were readily found in the rubbish at the collar of the plants attacked. The larvæ appear to be gregarious, as they fed in numbers on the same plant, over which they spun an intricate web, along which they traveled with alacrity when disturbed. *Remedies:* We made our first application of Paris green June 1, using 1 pound of the poison to 100 gallons of water, which proved to be very effective and not injurious to the plant, but we had to make a second application on the 20th of June, and finally on July 3, after which garden plants which had been treated were not further troubled, although mature larvæ were to be obtained for some days afterwards on fields of alfalfa. We used a hand machine to spray a 6-acre garden.

Pea weevil (*Bruchus pisi*).—This weevil continues to damage field and garden peas considerably. Our seeds of all the varieties grown this season are affected more or less. *Remedies:* These insects usually remain in the peas all winter, so that if the affected stock is kept over another season in tight vessels, the beetles are of course destroyed.

Southern cabbage butterfly (*Pieris protodice*).—The larva of this butterfly is the most injurious of the cabbage caterpillars to the gardener in Colorado. It was present in this State the past season in force, flitting over fields of cabbages in increased numbers over previous years. Of other cabbage worms we noted *Pieris oleracea*, *Plusia brassicæ*, and *Ceramica picta*, though not in numbers sufficient to cause much damage. The latter species I have taken on the soft maple. *Remedies:* Against these caterpillars we applied successfully, on July 26, the kerosene emulsion and Ongarth's liquid tree protector. The latter is the more effective of the two, as it sticks to the foliage better, and, while killing when it comes in contact with the caterpillar, it also seems to render the plant obnoxious to insect life.

False chinch bug (*Nysius angustatus*).—This insect appeared in market gardens in this vicinity last June for the first time. It first appeared on radishes, clustering in large numbers in the shade of the leaves near the ground. It next attacked a field of turnips, showing a preference for certain varieties, but avoiding all varieties of the rutabaga. It also did some damage to cabbage and cauliflower, but confined itself particularly to the two plants mentioned. *Remedies:* This is by far the most difficult insect with which I have had to contend the past season, because of its rapid movements and great numbers. I applied the kerosene emulsion, diluting the latter with nine parts of water; also applied Ongarth's liquid tree protector, and hellebore, both as a powder and mixed with water. The first two are very effective whenever the liquid comes in contact with the insect, but, owing to their vast numbers and ability to fly, only a small proportion of them could be killed at one application. These insecticides were applied on July 26, August 3, 11, and 21. It would be desirable to burn all weeds and tops of vegetables, so as to afford these insects as few hiding places as possible.

Forest-tree insects.—Brief notes on the cottonwood beetle (*Plagiodera scripta*), poplar borer (*Saperda calcarata*), *Tortrix rosaceana*, leaf-rolling caterpillar (*Cacœcia semiferana*), elm-leaf caterpillar (*Vanessa antiopa*), pear-tree slug (*Selandria cerasi*), *Grapta interrogationis* and *G. progne*, forest tent-caterpillar, elm aphis, and *Telea polyphemus*.

Miscellaneous insects.—Brief notes on *Rhynchites bicolor*, *Systena mitis*, *Collops nigriceps*, *Conotrachelus leucophætus*, *Selandria rubi*, *Lytta cinerea* and *L. atrata*, *Haltica striolata*, *Heliothis armigera*, *Trupanea aphidivora*, *Lema trilineata*, and two undetermined species of *Erythroneura*.

BULLETIN NO. 7, APRIL, 1889.

INTRODUCTION, C. L. INGERSOLL, M. S. (p. 2).

It has long been supposed that the arid region presented such new and changed conditions of soil and atmosphere, that nearly all plants grown under these conditions would change in one way or another from their normal condition as grown in Eastern States in different latitudes. This has been found to be true of the wheat plant, and to some extent the other cereals. The Experiment Station of Colorado has undertaken the examination of other plants. It has carried on the work begun two years ago in potatoes, and added the chemical analysis of three hundred and three varieties for the content of starch, in order that some general comparison could be made with Eastern and Southern grown varieties. Within a few years Colorado potatoes have become well known for their elegant table quality. It is the aim of this Station to grow, comparatively, many varieties, and to originate from seed new ones, in order to improve upon these we now have, if possible to do so. The work has been well done, and we hope will meet the needs of the State. The investigation of the sugar-producing problem is important, and will be continued.

POTATOES AND SUGAR BEETS, JAMES CASSIDY, B. S., AND D. O'BRINE, D. SC. (pp. 3–23).

Experiment with potatoes (pp. 3–21).—This was an experiment on half an acre of clay loam soil, in two plats of one-fourth of an acre each, to test named and seedling varieties of potatoes, and the planting of one-eye sets as compared with whole tubers. One-eye sets of the named varieties and medium-sized whole tubers of the seedlings were used. The latter appeared above ground five days earlier than the former and, in agreement with previous experience, gave the largest yield and the most vigorous development of tops. The yield was very light, owing to the heat and dry weather of July and August. The seedling varieties used were the best of over two thousand kinds raised at the Station during the past three years. Some of them in other hands and in peculiarly favorable soils gave better results the past season than did standard varieties grown under the same conditions. Most of the named kinds had not been tried here before. This test was chiefly valuable as showing what varieties do best under adverse conditions. Tables give the number of hills planted, the yield in pounds, the per cent of starch, the condition of the tubers April 1 in regard to sprouting, and notes on the shape and appearance of the tubers, for one hundred and twenty-six named and ninety-four seedling varieties. The average per cent of starch for the seedlings was 18.85 per cent; for the named kinds, 17.17 per cent. The most prolific among the named kinds were Stray Beauty, Red Elephant, Grange, Bliss's Triumph, Summit and Jordan's Russet, in the order named.

Notes on the determination of starch in potatoes.—This article contains a description of Sachsse's method as used by the chemist for determining the starch in potatoes, and also an account of experiments to test the influence of various modifications of this method of analysis on the per cent of starch obtained.

(*a*) Different lengths of time of heating in acid solution on water bath. The percentages of starch obtained by heating one, two, three, or six hours were nearly the same, but when the heating was prolonged to nine hours 0.6 per cent less starch was obtained.

(*b*) On heating in closed bottles in water bath for three, six, and nine hours the percentages of starch obtained were 17.80, 18.40, and 18.00, respectively.

(*c*) Three-tenths of a gram of crude starch mechanically separated from the potatoes by grating, pulverizing, and washing on a fine linen filter and drying at 100°C. when heated as in Sachsse's method for three, eight, and twelve hours gave 0.309, 0.306, and 0.304 grams, respectively.

(*d*) When sulphuric acid was used instead of hydrochloric acid in Sachsse's process, 0.25 per cent. less starch was obtained.

(*e*) In a single determination by each, Allihn's method gave essentially the same results as Sachsse's, but the author prefers Sachsse's because, as used by him, Allihn's method requires more time.

Sugar beets (pp. 21–23).—This contains an account of a field experiment with four varieties of beets (Lane's Imperial, Excelsior Sugar, Vilmorin Sugar, and Improved Imperial Sugar) and the method and results of chemical analysis to determine their sugar content. The produce of beets per acre was from 24.2 to 30.4 tons and the amount of sugar from 4,250 to 5,695 pounds per acre.

It will be seen that there is quite a wide variation in sugar content in the four varieties tried last season. Enough, however, has been developed to create a lively interest in the cultivation of the sugar beet in this State for purposes of sugar production. The serious drawback seems to be the cost of the diffusion plant, as quite a large amount of capital is required to prepare a suitable plant and furnish adequate machinery.

CONNECTICUT.

The Connecticut Agricultural Experiment Station.

Location, New Haven. Director, Samuel W. Johnson, M. A.

BULLETIN NO. 96, JANUARY, 1889.

This bulletin describes an attempt to establish a method of valuation for mill-products which are used as feed for dairy stock. It also contains analyses of a considerable number of feeds which are now being sold in Connecticut. Some of these feeds are of excellent quality and others are very poor or worthless, or are sold at exorbitant prices.

A condensed statement is also given of the proximate composition of all the feeds in common use, and of the digestible matters contained in a ton of each, together with the quantities of nitrogen, phosphoric acid, and potash per ton.

The contents of this bulletin were included in the Annual Report of the Station for 1888, a digest of which was published in Experiment Station Bulletin No. 2 of this office.

FEEDING STUFFS (pp. 1–15).

Methods of valuation (pp. 1–5).

An attempt has been made by this Station to find out and analyze all the feeds now in the Connecticut market whose average composition is not already known, and also to offer some method of comparison or "valuation" for them.

The method here to be described is not a new one. It has been used abroad, where feeds, like fertilizers, are sold under guarantee as to composition and the seller is obliged to make good any deficiency. The application of the method to American feeds and prices, we believe, has not been attempted before, probably because sufficient data have not been in hand.

Analyses (pp. 5–12).—This article contains analyses of "Columbia Cured Feed for Horses and Cattle," the "Concentrated Feed for Horses, Cattle, Sheep, Swine, Poultry, etc.," the "Concentrated Egg Producer," which are not recommended, and of cotton-seed bran, rye feed, oat middlings, barley screenings, oats, buckwheat middlings, maize kernel, old process linseed meal, gluten No. 1 feed, malt sprouts, Glen Cove starch feed, and apple pomace. Money valuations accompany the analyses.

Average composition of the winter food for dairy stock in Connecticut (pp. 13–15).—This article includes tables giving the average composition of several kinds of hay, maize fodder, stover and kernel, wheat bran, middlings and shorts, oat bran, rye bran, cotton-seed meal, linseed meal, hominy chops, malt sprouts, gluten meal, brewers' grains, and "starch feed."

BULLETIN NO. 97, APRIL, 1889.

FUNGOUS DISEASES OF PLANTS, ROLAND THAXTER, PH. D. (pp. 1, 2).—This article calls the attention of farmers and others to the recently established department of mycology, and contains a list of questions on onion smut, sent to onion growers.

FERTILIZERS (pp. 3–13).

Duties of dealers in fertilizers (p. 3).

Gratuitous analyses of fertilizers (pp. 3, 4).

The trade values for 1889 *of fertilizing ingredients in raw materials and chemicals* (pp. 4, 5).

Valuation of superphosphates, special manures and mixed fertilizers of high grade (pp. 5, 6).

Fertilizer analyses (pp. 6–13).

The analyses reported include those of ashes from small birch-boughs, tobacco stems, cotton-seed meal (a mechanical analysis is given of two of the samples of cotton-seed meal in addition to the chemical analyses), nitrate of soda, sulphate of ammonia, potash salts, and cotton-hull ashes.

Cotton-hull ashes have been for some years the cheapest source of potash on the Connecticut market. The potash is soluble in water, is entirely free from chlorides, and is combined chiefly with phosphoric and carbonic acid. The ashes are now used chiefly on tobacco lands, but are worth the attention of all who buy raw materials rather than mixed fertilizers. The only thing which stands in the way of their more general use is the uneven quality of the material, due to the fact that the hulls are often burned together with coal, so that the hull ashes are mixed with considerable coal ashes.

Analyses of ground bone, tankage, dissolved bone-black, and special manures are also reported. With the analyses are given the cost and money valuation per ton, or data from which the valuation can be easily calculated. The following table of costs of valuable ingredients is culled from the bulletin:

	Number of analyses.	Cost per pound.
Nitrogen:		*Cents.*
From cotton-seed meal	3	12.2 -13.5
From castor pomace	1	18.3
From nitrate of soda	2	17.4 -17.5
From sulphate of ammonia	2	17.9 -18.3
Potash:		
From potash salts	7	4.0 - 5.9
From cotton-hull ashes	9	3.23-10.4
Phosphoric acid:		
From dissolved bone-black	3	7.2 - 8.3

BULLETIN NO. 98, JUNE, 1889.

HOME-MIXED FERTILIZERS (pp. 1–7).

This bulletin contains analyses of eleven samples of home-mixed fertilizers sent to the Station this year, with such facts as could be obtained regarding their cost, etc. The formulas by which the fertilizers were mixed are first given, followed by the table of analyses and valuations, with some explanations and further remarks regarding them. * * *

The average cost of materials for the fertilizers referred to in this bulletin has been $33.79 per ton, delivered at the purchaser's freight station. Two dollars will fully cover the cost of screening and mixing. [From $1 to $1.50 is the estimate of those who have done the work.] At the highest estimate, therefore, the average cost of these home-mixed fertilizers has been $35.79 per ton. The average valuation has been $38.83 per ton. In no case has the valuation been less than the cost of the chemicals mixed. The valuation of ready-mixed fertilizers, on the other hand, is quite uniformly less than their cost.

The advantages claimed for home-mixing are:

(1) Each ingredient can be separately examined by the purchaser, and if necessary sent to the Experiment Station for analysis. The detection of inferior forms of nitrogen or phosphoric acid is much easier and more certain in a single article than in a mixture.

(2) It is self-evident that an intelligent farmer, by home-mixing, is better able than any one else can be to adapt the composition of his fertilizers to the special requirements of his land as well as of his crop, and how greatly the soil requirements vary in this State, even over a small area, is strikingly shown by the field experiments annually reported by our farmers through the Stations.

(3) It is claimed that the same quantity and quality of plant food costs much less in home-mixtures than in ready-made mixtures, because the cash purchaser of fertilizer chemicals deals directly with the importer or manufacturer, not with the middleman or retailer, and receives quotations without reference to the prices asked in his neighborhood by retailers of the same goods.

There is no longer any question as to the expediency of home-mixing in many cases.

From such raw materials as are in our markets, without the aid of milling machinery, mixtures can be and are annually made on the farm which are uniform in quality, fine and dry, and equal in all respects to the best ready-made fertilizers.

The economy of home-mixing depends, of course. on the prices which sellers of mixed goods are willing to take and on the cost of fertilizer-chemicals delivered as near the farm as mixed goods can be bought. There is always a chance for the farmer who studies the market and the needs of his farm to save enough in the purchase of his fertilizers to make just the difference between profit and loss on a crop; and in farming, as in everything else where competition is close, profit usually comes from care in these small margins of expense. Perhaps home mixtures are not, indeed, always and everywhere cheaper or more economical than commercial mixtures, but it will often happen that money can be saved by the timely purchase of raw materials and their mixture on the farm. Each individual farmer ought to be the best or only judge of the economy of home-mixing in his particular case, as well as of the "formulas" which are best adapted to his soil and crops.

BULLETIN No. 99, JUNE, 1889.

FERTILIZER ANALYSES (pp. 1–5).

Wool waste.—The sample analyzed appeared to be made up mostly of "tag-locks," unwashed wool containing considerable sheep dung. * * *

With nitrogen reckoned worth 8 cents, phosphoric acid 7 cents, and potash 4½ cents per pound, the total valuation will be $10.57 per ton. This slowly decomposing fertilizer is especially suitable for fruit-trees and grape-vines or grass, where an enduring rather than quick effect is desirable.

The article also contains analyses and valuations of "damaged corn-meal," cotton-seed meal, and castor pomace.

Reckoning phosphoric acid and potash at 7 and 6 cents per pound, respectively—the rates used in the valuation of mixed fertilizers—nitrogen in cotton-seed meal costs from 12.4 cents to 14.9 cents per pound, and in castor pomace about 19 cents. The price of castor pomace has advanced $5 a ton since last year, and in consequence it has become one of the most expensive sources of nitrogen, while last year it was one of the cheapest. Cotton-seed meal has also advanced in price, but still remains the cheapest source of available nitrogen.

Bone manures.—Since the establishment of this Station, twelve years ago, there has been a great improvement in the mechanical condition of the bone manures sold in Connecticut, as is seen from the table, which gives the average fineness of all those which have been analyzed here during that period.

The fertilizing value of fine bone is much greater than that of coarse bone. The latter may lie in the ground for years, while very fine bone is readily decomposed and taken up by plants. The improved condition and increased value of our bone manures is, to some extent, a result of the action of this Station, which, in the year 1879, first carried into effect the method of valuation based on the mechanical as well as the chemical analysis. Nitrogen in the finest bone is now worth 16½ cents per pound, while that in the coarsest bone is valued only at 8½ cents, and phosphoric acid is valued at 7 and 4 cents in the two grades, respectively. Very finely ground bone is, at present, one of the cheapest sources of quickly available nitrogen and phosphoric acid.

The analyses of twenty samples of bone manures are reported in tabular form.

Storrs School Agricultural Experiment Station.

Connected with Storrs Agricultural School.

Location, Storrs. Director, W. O. Atwater, Ph. D.

BULLETIN No. 3, FEBRUARY, 1889.

This bulletin was included in the Annual Report of the Station for 1888, a digest of which was published in Experiment Station Bulletin No. 2, of this office. The topics are:

ROOTS OF PLANTS AS MANURE (pp. 1–7).

Observations on the roots of grass, clover, etc.

Weight of roots and stubble in one acre.

Fertilizing materials in roots.

METEOROLOGICAL OBSERVATIONS (p. 8).—A summary of observations for October, November, and December, 1888.

DAKOTA.

Dakota Agricultural Experiment Station.

Department of Dakota Agricultural College.

Location, Brookings. Director, Lewis McLouth, Ph. D.

BULLETIN No. 9, JANUARY, 1889.

EXPERIMENTS WITH CORN, LUTHER FOSTER, M. SC. (pp. 1–8).*

The corn experiments embraced a set of 39 plats, each containing 60 rows, 24 hills in length. Thirty-three of these plats were planted with different varieties of corn, 18 of dent and 15 of flint, the rest being used for experiments in deep and shallow cultivation. * * * The early part of the season was not favorable for corn-growing, being cold and wet. * * * The stand in general was poor, resulting in part from unfavorable weather and bad seed, but principally from the work of ground-squirrels. * * * It was observed in all the plats that the earlier plantings grew larger and stronger than the after ones, and that the silks and tassels made their appearance more regularly.

The results of a single season's work are only entitled to the public attention as showing the scope of the experiment undertaken.

Definite results of any practical value to the farmer can only be obtained by a continuance of the same experiment, under a system of careful observations, extending through a number of years. Of this a beginning has been made.

Details of the results are given in tabular form.

Deep and shallow cultivation of corn (p. 8).—The deep cultivation was

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[*] These experiments are in a line indicated by the director at the time of the organization of the Station in a communication which was printed in the Report of the Committee on Station Work of the Association of American Colleges and Experiment Stations, published by the Commissioner of Agriculture in the spring of 1888. The communication contained the following:

Corn.—To plant a plat of all the quick-growing varieties of corn we can find every day through May, and keep record of date, cultivation, the reaching of several stages of its growth, and of its maturity, for the purpose of helping to settle the question of corn culture for southern Dakota, the corn season, and the kinds to plant. Wheat and flax have been nearly all the crops grown heretofore until last season, when much corn was planted and matured.

made with a double-shovel plow; the shallow with a spring-tooth cultivator. The difference in average weight of stalks and bushels per acre of corn was slight. The experiment was impaired by early frost.

BULLETIN No. 10, FEBRUARY, 1889.

THE GERMINATION OF FROSTED GRAIN, C. A. KEFFER (pp. 3–8).—This article records an experiment with eighteen samples of frosted grain, including two samples of barley, one of oats, and fifteen of wheat, to determine the vitality of such seed. The experiment was made in response to numerous requests for information as to the value of frosted and stack-burned grain for seed.

Different methods for determining the percentage of germination were employed. Fifty seeds of each sample were drilled in black soil, in shallow boxes, which were then placed in the propagating house, where they would have a gentle bottom heat. The soil used was taken from a field that had never been manured.

A number of samples, as shown by the table, were placed in carpet-paper cells; the paper is thick and porous, and retains moisture well, thus inducing germination. Still other samples were placed on small squares of carpet-paper in flower-pot saucers, and these were saturated with water and set one on top of another, thus having an air-space of an inch over each sample. * * *

A comparison of the table, with the figures showing the percentage of germination, will show that seeds do not germinate in the ratio of their plumpness. Of sample No. 4, containing 40 per cent of plump seeds, only 54 per cent germinated, while of sample No. 3, containing but 7 per cent of plump seeds, 82 per cent germinated. In the latter sample by far the greater proportion of the grains—75 per cent—were badly shriveled, while in sample No. 4 but 32 per cent were badly shriveled. * * *

It would not be safe to lay down any arbitrary rule for the use of frosted grain for seed. Neither would it be fair to conclude, from these experiments, that all seeds in which the germ is uninjured will produce good plants, however shriveled the grains may be. On the contrary, the investigation suggests unusual care in the preparation of the soil and in seeding.

If careful testing shows that a fair percentage of injured grains will germinate, the planter should not conclude that mere germination insures a good crop. Granted that the germ is uninjured (and this is determined when the seeds grow) the plump grain must be taken as the perfect seed, because it is completely filled with plant food, and the seed is good in proportion to its plumpness. Much can be done to aid the growth of shriveled grain; careful preparation of the soil, and planting when the weather is most favorable, are points largely within the control of every farmer. May it not be, also, that with good weather and well prepared soil, comparatively shallow seeding will be advisable?

BULLETIN NO. 11, MARCH, 1889.

FIELD EXPERIMENTS WITH WHEAT, OATS, AND BARLEY, LUTHER FOSTER, M. SC. (pp. 3–8).—Trials were made with sixteen varieties of wheat, nineteen of oats, and thirteen of barley. The times of maturity and amounts and quality of produce were observed.

Experiments in sowing broadcast and with the roller-press drill were also made. "From these some special points in favor of the latter method may be briefly stated as follows:

(1) Quick germination is insured by the seed being put at once into moist soil and the covering firmed by the rollers.

(2) The wind instead of laying bare the seed rather deepens the covering by partially filling up the tracks of the rollers.

(3) Economy of seed through the certainty that all is covered.

(4) The weeds are not so rank and interfere less with the growth of the grain."

BULLETIN NO. 12, APRIL, 1889.

FORESTRY, C. A. KEFFER (pp. 3–13).—This bulletin contains an account of the operations in forestry undertaken at this Station.

In the month of October, 1887, a plat of ground containing about 3 acres, lying north of the college buildings, was planted with tree seeds, the intention being to permit the trees to stand where they grew, and thus secure a windbreak for the buildings and campus. The ground used is at the crest of a slight elevation which slopes to the west for about half a mile to a small creek. The soil is black, with a stiff yellow clay subsoil, in which there is a little sand. While not "hard pan" this subsoil is far from being porous in the usually accepted meaning of the word. The same soil is found in all the plantations of this department of the Station, and is most common in this part of Dakota.

The varieties planted were box elder, white ash, black wild cherry, honey locust, white oak, burr oak, red oak, black walnut, white walnut or butternut, chestnut, hard maple, shell-bark hickory, basswood, and black locust.

Trees on the college lawn (pp. 5–8).—"In Bulletin No. 1 the conditions under which the trees on the college lawn are growing and the methods of planting and culture were fully explained. The past season has impressed me more fully with the value of some varieties named in that bulletin, notably the white elm and the European larch."

This article contains notes on the different varieties of trees growing on the college lawn.

The forest tree nursery (pp. 8–12).—"In the spring of 1888 the following varieties of trees, ranging in quantity from two hundred to two thousand, were planted in the nursery: European larch, yellow birch, black wild cherry, European white birch, box elder, white ash, white elm, cottonwood, soft maple, white walnut, black walnut, white oak, basswood, Scotch pine, white spruce, balsam fir, Norway spruce, Colorado blue spruce, Douglas spruce, arbor vitæ, white pine, red cedar, Black Hills native spruce (*Picea alba*), Black Hills native pine (*Pinus ponderosa*), hemlock, red pine, gray pine.

In addition to these, about five thousand cuttings, including *Populus certinensis*, *P. pyramidalis*, *P. nolester*, *P. pyramidalis suavolens*, *Salix laurifolia*, *S. fragilis*, were planted." This article contains notes on the trees in the nursery.

The evergreens (pp. 12, 13).—"About ten thousand evergreens of the varieties named in the bulletin were planted in the same way as the deciduous trees." The methods of planting and culture are described, and the number of trees of each kind planted, as well as the number alive at the end of the season, is stated.

BULLETIN NO. 13, APRIL, 1889.

INSECTS AND INSECTICIDES, I. H. ORCUTT, M. D., PH. D. (pp. 3--28).—This contains practical directions for the catching, preserving, and transportation of insects, and for the use of insecticides; an illustrated account of spraying apparatus; and compiled notes on the following insects: Cecropia emperor moth (*Platysamia cecropia*, Linn.), American silk-worm (*Telea polyphemus*, Linn.), sphinx moths (*Sphingidæ*), elm saw-fly (*Cimbex americana*, Leach), yellow-spotted willow-slug (*Nematus ventralis*, Say), streaked cottonwood leaf-beetle (*Plagiodera scripta*, Fabr.), cut-worms, southern cabbage butterfly (*Pieris protodice*, Boisd.), imported cabbage butterfly (*Pieris rapæ*, Schrank), cabbage plusia (*Plusia brassicæ*, Riley), zebra cabbage-worm (*Ceramica picta*, Harris), cabbage plant-louse (*Aphis brassicæ*, Linn.), Colorado potato beetle (*Doryphora decemlineata*, Say), and striped cucumber beetle (*Diabrotica vittata*).—The following items are of special interest:

Cecropia emperor worm.—These worms were found at this Station during the past summer destroying the box-elder, maple, willow, cottonwood, plum, apple, cherry, mountain ash, elm, catalpa, etc. * * * The destruction has been so great in many places it is feared that tree-raising must be abandoned if something is not done to check them. If the cocoons are collected in a given locality there will be no worms the following season. The cocoons may be torn down from the tops of the larger trees with a hook fastened to a pole. By opening a number of cocoons and carefully comparing the weight of those containing healthy pupæ with those which do not, it is not difficult to assort them. *Only those containing healthy pupæ should be destroyed, as many of the others contain the pupæ of one of the cecropia's greatest enemies and the farmers' faithful friends.* Cocoons may be kept in boxes (on shelves if many are to be preserved) with one-half inch holes bored in them. The holes will not allow mice to enter, but will allow small insects to escape. If the cocoons have not been assorted moths will appear about the first of June, which may be taken out and destroyed. The friendly insects may not appear until several weeks after the moths have been destroyed. If the cocoons are carefully gathered and cared for, as stated above, the relative number of the parasitic insects to the number of cecropia larvæ will be greatly increased, as few cocoons need be overlooked in gathering. This will enable the small insect friends to almost annihilate the large enemies. If the worms are not numerous they may be picked off and destroyed. *One man writes that he cut about twelve thousand in two with shears last summer.* They may be destroyed, without being handled, by pouring a few drops of kerosene along the back from a can with a very small nozzle. If the trees are large they can be fastened to a long pole at an angle, and be used by a person standing some distance from the tree. If but few trees are to be protected, this seems to be by far the better way to proceed. Use but a few drops of kerosene on each worm, as it will kill the leaves if poured on them.

Elm saw-fly.—These saw-flies are frequently regarded as "big hornets" by careless observers. The abdomen of the male varies in color from brick-red to shiny-black, while the abdomen of the female is plainly marked along each side with white. These insects appear the last of May or first of June, and begin at once their work of destruction upon the willow, soft maple, etc. They are provided with very powerful jaws for cutting slits in the bark, and with long tongues for lapping up the sap. One jaw is forced into the bark, the other is securely fastened a little to one side, when, with a powerful effort, the first jaw is drawn through the bark toward the second. This operation may be repeated till the branch is completely girdled. The sap is carefully lapped up as the operation progresses, and if the branch does not die the scars may be seen years afterward.

BULLETIN No. 14, APRIL, 1889.

THE SUGAR BEET, J. H. SHEPARD, M. S. (pp. 3–6).—An account of preliminary experiments with seven varieties of sugar beets to ascertain if such beets are adapted to the soil and climate of Dakota. The yields and sugar content were sufficiently encouraging to justify repetition of the experiments.

DELAWARE.

The Delaware College Agricultural Experiment Station.
Department of Delaware College.
Location: Newark. Director: Arthur T. Neale, Ph. D.

BULLETIN No. 4, MAY, 1889.

INJURIOUS INSECTS, IDENTIFICATION AND EXTERMINATION, M. H. BECKWITH (pp. 3–19).

Original investigations in entomology will be undertaken as soon as facilities are secured for this line of work. At present, however, the demand in Delaware is—

(1) *For instruction regarding the habits of well-known insect pests.*

(2) *For the description of thoroughly tested remedies, and of the proper methods of using them.*

For the purpose of obtaining data, seven thousand copies of a circular were mailed to the farmers and fruit-growers residing in the State. In this circular information was requested relative to the appearance of new insects, as well as to the amount of damage to crops caused by the familiar forms.

Forty different species were reported. Those mentioned as being especially abundant and causing the greatest injury are noticed in this bulletin.

The bulletin contains short compiled accounts of the following insects: Asparagus beetle (*Crioceris asparagi*, Linn.), rose beetle (*Macrodactylus subspinosus*, Fabr.), striped cucumber beetle (*Diabrotica vittata*, Fabr.), Colorado potato beetle (*Doryphora decemlineata*, Say), plum curculio (*Conotrachelus nenuphar*, Herbst.), codling moth (*Carpocapsa pomonella*, Linn.), white cabbage butterfly (*Pieris rapæ*, Linn.), gooseberry saw-fly (*Nematus ventricosus*, Klug.), and tomato worm (*Heliothis armigera*, Hüb.).

BULLETIN No. 5, JUNE, 1889.

THE INSPECTION OF SEED AND OF STOCK FEED IN DELAWARE, A. T. NEALE, Ph. D. (pp. 3, 4).—This introductory article gives a brief account of the work of a force of inspectors recently organized by the Station to collect samples of seed sold in Delaware. The purity and vitality of the seed thus obtained were tested at the Station. Director Neale calls attention to the fact that a very important result of the work done in fertilizer control by American and European stations has been to show that "farmers need teachers quite as much as they need detectives," and implies that this will prove equally true in regard to seed control. The principal difficulties with the seed commonly sold in the markets are lack of vitality, *i. e.*, germinating power, and impurities, including not only dirt, which does little harm, but also seed of weeds and parasitic plants, some of which are very harmful. The Delaware Station is striving not only to detect imperfections and impurities in seed, but also to show the farmer the desirability of seed control and to point out the dangers lurking in the seed he uses, which may easily escape his observation, and possible economies in the use of seed he sows.

Early in February, 1889, the Station appointed twelve inspectors and assigned to each a separate district in the State, which embraces in every case from one to three of the local divisions called "hundreds." The duty of an inspector was defined to be the selection of one or more samples of every kind of seed and feeding stuff offered for sale in his district. The aim of this inspection was to learn definitely the kinds, the quality, and the retail prices of the above-named materials, as sold in Delaware.

A complete list of the inspectors is given, and tables show the number and sources of the samples of seed which each one secured. Prior to April 1 some two hundred and twenty samples of seeds and fifty samples of feeding stuffs were received at the Station's laboratory. The analyses of the feeding stuffs are still in progress, and will form the subject of the next bulletin.

SEED TESTING, F. D. CHESTER, M. S. (pp. 5–32).—The importance of this work is urged; attention is called to the fact that "little has thus far been done by the American stations toward exercising control over the seeds sold in their several States;" the article also contains directions for the collection of samples; accounts of the methods of examination, and a copy of the form used for the report of the test; reports of tests, with explanations and practical conclusions, and a series of tables in which the results of examination of seeds are given in detail. The tests were of two kinds, purity examinations and germination tests.

Impurities.—The purity examinations show that the seeds sold in the State during the present season have been fully up to the average. The average results of the tests made at this Station are compared with calculations of Prof. A. R. Ledoux (see Annual Report of North Carolina Station for 1880) for American and German seeds. The outcome is very favorable for the Delaware seeds compared with those of the United States in general, and for those in the United States as compared with the German. As regards the grasses, however, Ledoux's calculations are less favorable to those sold in the United States. In the Delaware examinations, "garden vegetables, in accordance with experience elsewhere, give, as a rule, a high percentage of purity, and are comparatively free from foul weed seeds."

Nature of the impurities.—The kinds and amounts of all the weed seeds found in the grasses and forage plants are given in a table showing the number of samples of seeds in which each kind of weed was found. Thus, in one hundred and forty-eight samples of seeds sold in Delaware, forty-four contained plantain (*Plantago major*); twenty-seven, sheep sorrel (*Rumex acetosella*); twenty-five, rag weed (*Ambrosia artemisiæfolia*); five, dodder (*Cuscuta*); and one, Canada thistle (*Cnicus arvensis*). Twenty-six different species of weeds were found in the samples tested.

"This list tells its own story, as to how the majority of weed seeds get upon the farm; for not only is the farmer sowing them, but, as Ledoux has remarked, he is sowing them upon well prepared land, where they will be sure to grow."

Quantity of impurities.—One sample of red clover seed contained 9.2 per cent of impurities. These were seeds of nine kinds of weeds, etc., among which were plantain, smart weed, rag weed, and foxtail grass. Taking 8 pounds of this clover seed, the usual quantity for an acre, the number of weed seeds was sufficient to give one seed of sheep sorrel every 4 feet in drills 3 feet apart; one of rag weed every 10 feet in drills 6 feet apart; the same number of dodder and enough of all the weed seeds of different kinds to make one seed every 6 inches in drills 9 inches apart. This, however, was rather an extreme case. Another sample of red clover, which came nearer the average, had 1.2 per cent of impurities by weight. If 8 pounds of this seed were sown on an acre, the number of weed seeds would be sufficient for one every foot in drills 15 inches apart.

"The tables show how it is possible, even by the use of a comparatively pure seed, to introduce upon land a supply of weeds which may, in time, overrun a farm to a serious degree; and when we consider that this process of sowing weed seeds is repeated from year to year, the argument has still greater force."

Dodder.—An account of the dodder (*Cuscuta trifolii*) is given. This parasite, which grows upon clover, alfalfa, etc., is in some cases a very serious pest.

"Every precaution is to be taken against the introduction of this parasite into the State. In Germany its presence has proved a national calamity and well nigh forced German farmers to abandon the growth of clover.

The flax dodder, according to Ledoux, broke up the culture of flax in North Carolina, and paved the way to cotton culture. In Germany, the fight against the *Cuscuta* has been vigorous, but the enforcement of stringent laws and the sharp eye kept by the German seed-controls over the quality of clover and alfalfa seed, has done much to reduce this evil."

A striking instance of the need of precautions in this country is given in a sample of alfalfa seed sent to the Station for examination. "The purchaser remarked that it was one of the purest seeds he had ever seen, and an examination proved this fact, the percentage of impurities being only .42, mainly dirt. But a close examination revealed the presence of *Cuscuta* or dodder seed at the rate of seven hundred and twenty to the pound. This seed, when sown at the rate of 15 pounds to the acre, which is about one-half that generally sown in Germany, would furnish nearly eleven thousand *Cuscuta* seed to the acre, or enough to give one seed every 2 feet in drills 2 feet apart. The sowing of this much *Cuscuta* seed upon an acre of land would, at the least, be a dangerous procedure, and might result in a total destruction of a crop in the course of two or three years."

Germination tests.—The percentages of vital seed, relation of vitality to rate of seeding, vitality averages (seed in one hundred capable of germination), duration of test, percentage of seed decayed, weight of seed and present value, are discussed and the results given in tables filling twelve pages; those of purity examinations filling the five pages which follow. A very convenient germinating apparatus in use at the Station is described. Samples were tested in duplicate and results which differed more than 10 per cent in germinating power were rejected. Comparisons of results in these investigations in Delaware, other parts of the United States, and in Germany are given in tabular form.

"The vitality of seed sold in the State during the present season has upon the whole been good, and well up to the average standard. This fact, in a State where no systematic control has ever before been in operation, is a source of congratulation. * * * The vitality of the clover seed is especially good. This also applies even more strongly to the timothy. The low vitality of the grasses, particularly of those less known to agriculture, but of intrinsic value, is a great drawback against the introduction of a mixed grass herbage in this country. The quality of the garden seed is generally above the standard."

Considerations are stated which imply that the "usual method of seeding is, in the majority of cases, excessive and perhaps wasteful."

FLORIDA.

Agricultural Experiment Station of Florida.

Department of Florida State Agricultural and Mechanical College.

Location, Lake City. Director, Rev. J. P. De Pass.

BULLETIN NO. 5, APRIL, 1889.

ANALYSIS OF FERTILIZERS, J. M. PICKELL, M. D., AND J. J. EARLE, A. B. (pp. 1–5).—The bulletin contains results of analyses of five samples of commercial fertilizing materials, one muck, one marl, three soils and one subsoil; and directions for taking and sending samples of soil, water, and fertilizers for analysis.

Florida is the only State east of the Mississippi River that has no law for the analyses of commercial fertilizers. * * * It is, nevertheless, the purpose of the Station to publish the results of analyses of fertilizers sampled from time to time in various parts of the State.

GEORGIA.

Georgia Agricultural Experiment Station.

Department of State College of Agriculture and Mechanic Arts, University of Georgia.
Location, Athens. Director, W. L. Jones, M. D.

BULLETIN NO. 2, JANUARY, 1889.

FACTORS IN AGRICULTURAL INVESTIGATIONS, W. L. JONES, M. D. (pp. 11–16).—An introductory article.

ASH ANALYSES OF NATIVE WOODS, H. C. WHITE, PH. D. (pp. 17–26).—A number of the more common native woods of Georgia were analyzed with a view to determine: (1) Their fuel value; (2) the amount and character of the mineral matter they contain; (3) the manurial value of the ash as commonly obtained. The woods examined were black hickory (*Carya tomentosa*), red oak (*Quercus rubra*), white oak (*Quercus alba*), post oak (*Quercus obtusiloba*), yellow pine (*Pinus mitis*), old field pine (short-leaved—the common variety of the upcountry—probably *Pinus mitis*), black pine (so called), dogwood (*Cornus florida*), red maple (*Acer rubrum*), ash (*Fraxinus americana*), chestnut (*Castanea vulgaris*), and sycamore (*Platanus occidentalis*). The results of the analyses are given in a series of tables.

ORIGIN OF SOILS GEOLOGICALLY CONSIDERED, J. W. SPENCER, A. M., PH. D. (pp. 27–31).—This contains notes on the origin of soils.

THE IMPORTED CABBAGE BUTTERFLY (PIERIS RAPÆ), J. P. CAMPBELL, PH. D. (pp. 32–35).—A compiled account of this insect.

FIELD EXPERIMENTS WITH PHOSPHATES AND KAINIT APPLIED TO COTTON, W. L. JONES, M. D. (pp. 35–37).—The object of these experiments was to compare the relative manurial values of phosphoric acid in acid phosphate, phosphate slag (Pine-Thomas process), and floats, and of kainit "in combinations such as are frequently used by farmers." The experiments were made on plats of one-tenth acre each. Each manured plat was duplicated. The kind of manure, rate per acre, and yield per acre in seed cotton are given. Attention is called to the variations in the yields of the unmanured plats, which, as is very common in such experiments, "shows forcibly the difficulty of getting a correct standard of comparison."

Aside from the inequalities of soil, the season was unfavorable and it is difficult to draw satisfactory conclusions. "Of phosphates, acid phosphate appears to lead, slag comes next, and the floats are last, * * * but when the relative cost of the acid phosphate and slag are considered, the apparent difference in favor of the phosphate is much reduced. Where kainit is used, other ingredients of fertilizer remaining the same, the yield is slightly increased."

SUMMARY OF METEOROLOGICAL OBSERVATIONS (p. 38).

Summary for four years—October, 1884 to October, 1888.

Year ending October 1—	Mean pressure.	Temperature.			Relative humidity.	Precipitation.		Days.	
		Mean.	Mean of maximum.	Mean of minimum.		Inches of rain and melted snow.	Inches of snow.	Cloudy.	Rain.
1885	30.04	59.666	80.91	33.29	70.834	60.02	1.26	114	107
1886	30.044	59.114	79.00	35.50	69.228	56.40	4.50	93	90
1887	30.018	59.950	81.75	36.00	68.558	50.48	2.00	77	77
1888	30.038	60.336	84.46	34.25	70.199	51.29	....	95	87
Sums	120.148	239.066	326.12	139.04	278.819	218.19	....	379	361
Averages	30.037	59.766	81.53	34.76	69.704	54.55	....	94.75	90.25

PRESERVATION OF THE SWEET POTATO IN WINTER, W. L. JONES, M. D. (pp. 39–42).—A record of one year's experience with sweet potatoes kept in a pit and in a dry well.

This experiment is published, not because it furnishes a basis for deduction, but to direct attention to this very important matter. If it was known exactly under what conditions sweet potatoes could be preserved through the winter, their cultivation would increase largely, for they are easily raised and can be converted into very cheap pork, milk, and butter.

BULLETIN NO. 3, APRIL, 1889.

ENTOMOLOGY, J. P. CAMPBELL, PH. D. (pp. 45–49).—Compiled notes on the melon worm (*Eudioptis hyalinata*, L.), pickle worm (*Eudioptis nitidalis*, Cram.), and harlequin cabbage-bug (*Strachia histrionica*, Hahn).

ADDITIONAL ASH ANALYSES OF NATIVE WOODS, H. C. WHITE, PH. D. (pp. 50–53.)—A continuation of the work recorded in Bulletin No. 2, (pp. 17–26). The woods examined were long-leaved pine (*Pinus palustris*) and magnolia (*Magnolia grandiflora*).

COW-PEA AS A FERTILIZING CROP—MANURES FOR, W. L. JONES, M. D. (pp. 54–58).—A record of experiments with fertilizers on cowpeas. "The pea responded promptly to mineral manures."

PRESERVATION OF THE SWEET POTATO IN WINTER, W. L. JONES, M. D. (pp. 59–61).—A record of the continuation of experiments reported in Bulletin No. 2 (pp. 39–42).

One or two conclusions only can be drawn at present; one is that sweet potatoes may be kept through the winter when the temperature to which they are exposed is within the limits of 38.1° and 88° Fah., and the average about 52°; another is that a damp atmosphere is not prejudicial to their keeping, neither is the presence of diffused daylight.

ILLINOIS.

Agricultural Experiment Station of the University of Illinois.
Department of the University of Illinois.
Location, Champaign. Director, Selim H. Peabody, Ph. D., LL. D.

BULLETIN NO. 4, FEBRUARY, 1889.

FIELD EXPERIMENTS WITH CORN,* GEORGE E. MORROW, A. M., AND T. F. HUNT, S. B. (pp. 37–127).—This article contains a detailed record of twelve field experiments with common dent corn.

Experiment No. 1.—*Corn, testing of varieties* (pp. 38–87).—One hundred and sixty varieties were included in these tests, for which about 8 acres of land were used. The results are given in detail in tables, together with summaries, general notes, and a record of the meteorological conditions for the season of 1887 and 1888. Classified descriptions of a large number of the varieties fill nineteen closely printed pages of the bulletin. In many instances these descriptions conclude with brief comments on the probable value of the different varieties to the farmers of Illinois, as far as any conclusion is warranted by the experiments.

The varieties are divided into early, medium, late, and non-maturing, with reference to the latitude of the Station. Those varieties maturing this season in one hundred and twenty-five or less days from date of planting are considered early; those maturing in from one hundred and twenty-five to one hundred and thirty-five days, medium; those maturing in from one hundred and thirty-five to one hundred and forty-five days, late. When corn became sufficiently hard not to be sensibly injured by frost it was considered mature.

The following varieties are recommended for cultivation in Illinois:

EARLY MATURING VARIETIES, FOR NORTHERN ILLINOIS.

Murdock (Synonyms, Prairie Queen, Will's Ninety-day, Goddard's Favorite, Dammell's, Bonus Prairie, Queen of the Prairie, Yellow Clauge (also in central Illinois as an early variety); Sibley's Pride of the North (North Star); Golden Rod; Edmond's Corn (also in central Illinois as an early variety); Kane County Pride (Synonym, Zeigler's Ninety-day); King of the Earliest (Synonym, Dakota Ninety-day); Hill's Improved Ninety-day; Champion of the North (Synonym, Ninety-day White); Smith's Mixed Dent, Smith's Improved White, Smith's Improved Striped (also in central Illinois as an early variety).

MEDIUM MATURING VARIETIES, FOR CENTRAL ILLINOIS.

Legal Tender; Riley's Favorite; Leaming (Synonym, Iowa King); Clark's One Hundred-day; Seek-no-further; Champaign; Log Cabin; Burr's White (Synonyms, Giant Normandy, Dresback, Champion White Pearl, Zeigler's Ninety-day, White Queen, Smith's Favorite, Hugh's Choice); Gourd Seed.

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* The character of these experiments, the accounts of which fill ninety closely printed pages, makes it impracticable to bring a satisfactory synopsis of them within the limits of the present publication. A more complete summary is therefore reserved for the Annual Digest of the work of the Stations.

LATE MATURING VARIETIES, FOR SOUTHERN ILLINOIS.

McConnell's Improved Orange Pride (probably desirable); Swengel Corn; Steward's Improved Yellow Dent (probably desirable); Piasa Pride (on fertile river bottoms, probably desirable).

Experiment No. 2.—Corn, test of varieties for ensilage (pp. 88–93).—Burrill and Whitman ensilage corn (a large, late, or non-maturing southern variety), Burr's White (a common, medium-maturing, dent variety), and Breck's Boston Market, were grown (the last on a smaller scale than the other two) in an experimental field. The details and results are summarized in five tables.

When harvested for the silo, the Burrill and Whitman ensilage corn was less mature, its stalks taller, and the total yield of corn fodder per acre much larger than was the case with the Burr's White. But the Burrill and Whitman contained much more water than the Burr's White, the latter having 40.5 per cent, and the former only 27.3 per cent of dry substance. Consequently the total amounts of actually nutritive material in the two were nearly the same, and the difference in yield was mainly in the amounts of water. The differences of composition of the dry substance of the two varieties were not large. The percentage of crude protein was appreciably higher in the Burrill and Whitman ensilage than in the Burr's White, although in each case it was about half that of the average of the American and European analyses on record.

"As shown in the tables, the Burr's White yielded 23,050 pounds, and the Burrill and Whitman ensilage corn 35,285 pounds of fresh substance, and 9,327 and 9,647 pounds, respectively, of dry substance, equal in weight to the dry substance of about 5⅓ tons of well-cured timothy hay.

The Burr's White yielded 324 pounds per acre less of crude fiber and 104 pounds more of nitrogen-free extract (starch, sugar, etc.) than the ensilage corn; while the ensilage corn yielded 4 pounds of crude fat, 25 pounds of crude ash, and 74 pounds per acre more of crude protein."

Experiment No. 3.—Corn, time of planting (pp. 93–96).—The object of this experiment was to observe the effect of planting at different dates upon the amount and quality of the crop.

"Seven plats measuring 2 by 8 rods each were planted with corn, one a week for seven weeks, beginning April 27 and ending June 8, 1888. * * * The hills were 3 feet 8 inches apart. Four kernels of Burr's White dent corn were planted in each hill."

The details and results are given in tables showing dates of planting, number of hills and plants, methods of cultivation, times when first and when fully in tassel, and other data. The final conclusion is stated as follows:

> This season, therefore, with the variety of corn named, a medium-maturing variety, and good soil and culture, the best results were obtained from planting between May 4 and 19, while satisfactory results were obtained during the period of five weeks, from April 27 to June 1.

Experiment No. 4.—Corn, depth of planting (pp. 96–98).—The object of this experiment was to observe the effect of planting at different depths upon the amount and quality of corn produced.

"May 4, 1888, six rows, each 8 rods in length, were planted with corn at depths varying from 1 to 6 inches. * * * There were 36 hills in a row, and the rows were 3 feet 8 inches apart. Four kernels of Burr's White dent corn were planted in each hill. The depth was obtained by means of a scale on a dibble."

Tables are given showing depths of planting, number of hills and plants in each row at dates given, ears and pounds of corn per row calculated, ears and bushels per acre, and ears per bushel. "So far as planting from 1 to 4 inches is concerned, the results are not at all decisive." The general conclusion is thus stated:

> Inasmuch as there is not a direct relationship between the depth of planting and the yield, some accidental cause of variation is indicated; that is, accidental as relates to this experiment. If another season's trial, when the possible error from outside rows is eliminated, gives the best result from planting 3 inches deep, then the present season's results will be of more value. * * * The best depth to plant will depend largely upon the temperature, moisture, and mechanical conditions of the seed-bed at the time of planting—three conditions which are, probably, rarely exactly similar in two different places or seasons. In this experiment, these conditions were all favorable to the early growth of the corn plant; and in such a case the depth of planting, between 1 and 4 inches, would make but little difference.

Experiment No. 5.—Corn, thickness of planting (pp. 98–106).—"This experiment was conducted with the object of determining the best thickness at which to plant corn, and also the best manner of distributing the corn at a given thickness—whether, for instance, it is better to plant three kernels every 3½ feet, or one kernel every 14 inches."

NUMBER OF STALKS.

With the same rate of planting, more stalks were produced where but one kernel was planted in a hill; but there was hardly any difference whether it was two, three, or four kernels to a hill.

WEIGHT OF STALKS AND EARS.

The average weight of one hundred stalks of corn varied from 61 pounds in the first and thickest planting to 150 pounds in the sixth and thinnest planting, there being a somewhat regular although not constant increase from the thickest to the thinnest planting. The average weight of one hundred stalks of stover* varied from 40 pounds in the thickest planting to 97 pounds in the thinnest planting, while the weight of one hundred ears raised from 23 pounds to 70 pounds. But the weight of stalks increased more than the weight of ears.

In this experiment the development of the plant seems to have depended mostly upon the thickness of planting, and but little upon the method of distribution. Although there were some very marked variations there was, in general, a great uniformity of results. To a small extent, however, better development was obtained where two or three kernels were planted to a hill than where one or four kernels were planted.

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* By corn-stover is meant the residue of the mature corn plant after the removal of ears; by corn-fodder, both ears and stalks, as proposed by Professor Armsby, Report of Pennsylvania State College Experiment Station for 1887, Part II., p. 145.

NUMBER OF EARS.

The number of ears per acre varied from 18,932 in plat 1, one of the thicket-planted plats, to 5,664 in plat 12, one of the thinnest-planted plats; about three and one-third times as many in one case as in the other. This would materially affect the cost of harvesting, and, unless there is a considerable increase in yield, the increase in ears would be undesirable. Taking an average of the first four plantings, the number of ears produced per acre, with one kernel to a hill, was 13,529; with two, 12,504; with three, 12,216; with four, 12,649. * * * It has been shown that where two and three kernels were planted to a hill the ears were a little larger than where but one was planted.

YIELD.

The average yield of corn-fodder, approximately, was, for the first planting, 9 tons per acre: the second, 8; the third, $7\frac{1}{2}$; the fourth, $7\frac{1}{2}$; the fifth, $6\frac{3}{4}$, and the sixth, $5\frac{4}{5}$. The average yield of stover, approximately, was 6, $4\frac{3}{4}$, $4\frac{2}{5}$, $4\frac{1}{3}$, $4\frac{1}{4}$, and 4 tons per acre, respectively. The average yield of shelled corn, approximately, was 89, 95, 87, 83, 72, and 60 bushels per acre, respectively. Of this quantity 32, 64, 71, 74, 61, and 55 bushels, respectively, were obtained from the good ears, and 57, 31, 16, 13, 11, and 5 bushels from the nubbins.

Taking the average of the first four plantings, where one kernel was planted to a hill, the yield was 92.8 bushels per acre; two kernels, 93.4; three kernels, 87.4; four kernels, 87.8, and of shelled corn from good ears there were 60.1, 66, 57.6, and 60.2 bushels per acre, respectively. There was a little more corn, and considerable more corn from good ears, where two kernels were planted to a hill.

Experiment No. 6.—*Corn, planting in hills or drills* (pp. 106, 107).—"This experiment was made to supplement Experiment No. 5. In that experiment the cultivation was the same whether there was one kernel every foot or three kernels every 3 feet. In ordinary practice, however, if corn is planted in hills, it is cultivated both ways; while, if planted in drills, it can be cultivated but one way. An acre of land was divided into two plats, each 8 by 10 rods. One plat was planted in drills with a corn-planter, one to three kernels of Burr's White Dent corn every 16 inches; the other was planted in hills 3 feet 8 inches apart, two to four kernels in a hill. * * * Although the test lacks the thoroughness desirable, the result is similar to results obtained in Experiment No. 5, viz, no marked differences from different methods of planting.

Experiments 8, 9, *and* 10.—*Frequency and depth of cultivation and root pruning of corn* (pp. 107–113).—These are practically one experiment with three sets of conditions. In No. 8, in which the effects of frequency of cultivation are tested, the comparison is between cultivating four times (ordinary cultivation), cultivating six times ("ordinary" and twice after tasseling in addition), and cultivating twelve times. In No. 9 the effects of deep and shallow cultivation are compared. In No. 10 the effects of root pruning are observed. The plats were treated by (1) scraping on the surface with a sharp hoe so as to remove weeds, but not stir the soil to any depth; (2) hoeing in the ordinary way, the ground being stirred 1 or 2 inches deep; (3) shallow cultivation, about 1 inch, with a cultivator; (4) deep cultivation, at least 3 inches, with a cultivator.

To test the effect of frequency of cultivation, some of the deep cultivated and shallow plats were cultivated four times during the season, others twelve times *i. e.*, three times as often as usual.

In each of the eight plats under experiment every other row was root pruned with a knife, which cut the roots about 3 inches deep and about 6 inches from the center of the hill, which is as close as a cultivator ordinarily runs.

As general results of the experiments it appears that (1) as to frequency of cultivation, there was practically no difference in the yield whether cultivated four, six, or twelve times; the only benefit from the extra cultivation was that the land was kept much freer from weeds; (2) as to depth of cultivation, the largest yield was with shallow cultivation (1 inch) and the smallest with deep cultivation (3 inches); the yield without any cultivation was less than with the shallow and more than with the deep cultivation; the weeds were more effectually destroyed by the deep than by the shallow cultivation; (3) as to the effect of pruning, no difference was observed between the pruned and unpruned rows in regard to size, vigor, or stage of maturity.

The yield of corn per acre was, on the average, 4 bushels more from the unpruned than the pruned rows. In no plat was the difference in favor of the pruned portion. The effect of pruning was greatest where the plats were cultivated least, and was least marked on those which had the most cultivation.

As to the general application of the above results, it is to be observed: (1) That in these experiments the soil was very fertile, being "newly broken sod, which is generally conceded to require less cultivation than old land;" (2) "that the season was unusually favorable for corn," and (3) that there was considerable rain during the time of cultivation and pruning, which may have helped the corn to recover from the injury of root pruning. "Final judgment may, therefore, be wisely delayed until the experiment can be repeated several years on the same land."

Experiment No. 54.—Corn, root growth (pp. 113–115).—The particular object of the inquiry was to ascertain the number of the roots and their depths at the points where they are likely to be disturbed by cultivation; what proportion of all the roots was sufficiently near the surface to be so injured; and whether by root-pruning 3 inches deep, as in Experiment No. 10, enough roots would be cut so that any considerable effect should be expected therefrom. To this end a few hills were examined just as they were found growing in the field by digging a trench beside the hill and washing the vertical side with water. Four hills were examined. They grew on a black prairie loam, which is 1½ to 2 feet deep, and is underlaid with permeable yellow clay. These investigations are as yet too limited to allow any general conclusions, but they will form the basis of future work in this line. Three-fourths of the roots would not have been broken by root-pruning or cultivating 3 inches deep; but all but one would have been at 4 inches deep.

Experiments No. 11 *and No.* 24.—*Comparison of effects of fertilizers on* *corn* (pp. 116–121).—These experiments were made to observe the effect of some of the common forms of commercial fertilizers, hog tankage and stable manure, on the yield of corn.

The stable manure was a mixture of horse and cattle manure combined with the usual litter. In both experiments it was applied before the land was plowed. The commercial fertilizers used in Experiment No. 11 were muriate of potash, dissolved bone-black, sulphate of ammonia and hog tankage separately, and a combination of muriate of potash and hog tankage. In Experiment No. 24, besides those already mentioned, cattle tankage, bone meal, glue-factory superphosphate and nitrate of soda were used. In Experiment No. 11 the fertilizers were sown broadcast on the plowed land.

No appreciable increase of yield was secured by the commercial fertilizers on this land this season, and the increase produced by the stable manure, used in Experiment No. 11, was not sufficient to pay for its use unless the surplus fertility left in the soil gives a more marked increase next year.

General conclusions and suggestions (pp. 121–127).—These, which fill six pages, "are suggested in part by the experiments reported in this bulletin and in part by those tried in previous years, and by experience in ordinary field culture of corn." They discuss varieties, improvement of varieties, soil preparation and fertilization, planting, cultivation, and harvesting. They do not easily admit of condensation, and are therefore reserved for the Annual Digest of the work of the stations.

GARDEN EXPERIMENTS WITH SWEET CORN, 1888, THOS. J. BURRILL, PH. D., AND G. W. MCCLUER, S. B. (pp. 128–138).

Experiment No. 49.—Sweet corn, testing varieties.—The classification adopted for the forty-seven varieties of sweet corn tested may be tabulated as follows:

Varieties.	Time of reaching edible maturity after planting.	Color.
Early	Sixty-three days or less	Yellow.
		White.
		Colored, not yellow.
Medium	Sixty-four to seventy-one days	White.
		Colored, not yellow.
Late	Seventy-two days or more	White.
		Colored, not white.

Detailed descriptions of the varieties fill eight closely printed pages of the bulletin in type. The results of the experiments are recorded in a table, showing number of plat, name of variety, date of first and full bloom, and when first ears were fit for use, days from planting to edible maturity, yield, weight of the selected ears, and per cent of full stand.

BULLETIN NO. 5, MAY, 1889.

GRASSES AND CLOVERS: EFFECT OF RIPENESS ON YIELD AND COMPOSITION, THOMAS F. HUNT, S. B. (pp. 141–164).

Experiment No. 50.—"The investigations reported in this bulletin were undertaken to ascertain the effect of cutting certain grasses and clovers at different periods of growth upon the yield of hay and its composition. The results obtained by several others who have made investigations on the same lines are also given, and the whole is believed to be a fairly comprehensive summary of the data so far accumulated upon this subject in this country."

This article contains explanations of technical terms used in statements of chemical analyses of grasses and clovers, including the terms co-efficient of digestion and nutritive ratio.

"Four grasses (timothy, Kentucky blue-grass, orchard grass, and meadow fescue) and two clovers (medium red and mammoth red) were used in the investigation. Incidentally there was some comparison of the varieties."

A record of the observations made during the season is summarized in five tables, and there is also a discussion of the composition and yields of green crop and hay at the different times of cutting.

YIELD OF GREEN CROP AND OF CURED HAY.

The yield per acre of green substance varied in the grasses from 3½ to 4¾ tons, and in the clovers from 4⅖ to 7¾ tons. The grasses lost while curing from 1¾ to 2⅗ tons.

LOSS OF WATER IN CURING.

With an ordinary yield the loss of water while curing in the field may be from 2 to 5 tons per acre. The loss is larger in the clovers than in the grasses. The loss in weight by drying after storing may be from 200 to 400 pounds per ton.

CHEMICAL COMPOSITION OF PRODUCTS.

An analysis of the results embodied in the tables given shows that while there are marked exceptions, there is, in general, a decrease in the per cent of water, crude ash, crude fat, and crude protein, and an increase in the per cent of crude fiber, and nitrogen-free extract as the plant matures during that period within which it is at all practicable to harvest the crop for hay. The increase of the non-nitrogenous over the nitrogenous portions has such few exceptions that they may be attributed to accidental variations of sampling. The decrease in the per cent of fat is quite general, but there are marked exceptions. The increase in the per cent of nitrogen-free extract is fairly general. The decrease of the crude protein and the increase of the crude fiber is more rapid in the clovers than in the grasses.

YIELD OF ACTUAL NUTRIENTS

The increase of yield of the grasses from the period of full bloom until seeds are formed is appreciable. There is an increase of all the food nutrients, but the increase is most marked in the crude fiber and nitrogen-free extract. * * * With the clovers there was a decrease of yield after the period of full bloom (when about one-half the heads are in full bloom). There was a decrease in all the nutrients, with the exception of crude fiber, in which there is sometimes an appreciable increase.

Whether the decrease in the digestibility of the grasses after full bloom will offset the increase of yield has not yet been determined. Presumably, the decrease in digestibility is not so rapid with the grasses as with the clovers.

ORCHARD GRASS *vs.* TIMOTHY.

While the yield of orchard grass was less than of timothy, the digestible organic substance being about three-fourths that of timothy, its composition and digestibility indicate a better quality of hay for milch cows and growing stock. Orchard grass does not seem difficult to grow successfully in this State. It ripens with medium red clover, which makes it desirable for mixing with that plant. Nevertheless, its cultivation is adopted slowly, It has generally been held to be less readily eaten by stock than timothy, and the cost of the seed probably retards its adoption and general culture for meadows. As a pasture grass it is conceded to be inferior to Kentucky blue grass for this State.

INDIANA.

Agricultural Experiment Station of Indiana.

Department of Purdue University.

Location, La Fayette. Director, Horace E. Stockbridge, Ph. D.

BULLETIN NO. 18, JANUARY, 1889.

EXPERIMENTS WITH VEGETABLES AND COMMERCIAL FERTILIZERS, JAMES TROOP, M. S. (pp. 1–11).—The experiments were conducted with two objects in view: (1) Testing commercial fertilizers; (2) testing varieties.

The bulletin contains a record of observations made during the season of 1888, on varieties of potatoes, sweet corn, onions, peas, and sugar beets, and also of plat experiments with fertilizers on potatoes, and is illustrated with a diagram of the horticultural experiment field of 10 acres, showing the situation of different kinds of fruits planted.

Commercial fertilizers on potatoes.—In this experiment each plat was surrounded by others of the same size which received no fertilizers. Several brands of commercial fertilizers were used. The Burbank potato was planted on all the plats April 26. The "Rural trench system" was used throughout. There were differences in the depth of trenches, in the planting of potatoes, and in the ways of applying the fertilizers. The drought of the season was very severe and materially interfered with the success of the experiment. Results are stated in detail in tabular form.

Varieties of potatoes.—The yield of seventy-seven varieties of potatoes is given in bushels per acre.

Varieties of sweet corn, onions, and peas.—Here are given tabulated notes on the development, yield, and quality of each of forty-five varieties of sweet corn; colors, sizes, and yields of twenty-eight varieties of onions; and dates of marketable maturity of thirty-two varieties of peas.

The question of deep versus shallow planting of peas was tested by drilling in one row about an inch deep with the Planet, jr., drill, another row being sowed in a trench and covered 4 inches deep. The result showed that the deep-planted peas came up first, and were ready for market two days before the others. There was no perceptible difference in the yield.

Varieties of sugar beets.—Several varieties of sugar beets and of the common blood beet were grown and analyzed at the Station. The yield varied from 219 to 482 bushels per acre and the sugar from 9.67 to 12.25 per cent.

Japanese vegetables.—A large number of varieties of vegetables, including beans, cabbages, radishes, and egg-plants, received from Prof. C. C. Georgeson, Tokio, Japan, were tested in the field, but the results this season were unsatisfactory. Experiments with them will be continued.

BULLETIN NO. 19, JANUARY, 1889.

THE BOTANICAL DEPARTMENT (p. 3).—This article contains a plan and brief description of the rooms and appliances of the botanical department of the Station. "The general laboratory is especially fitted for research in vegetable physiology." "The bacteria room has an excellent outfit for the study of microbes." "A greenhouse will shortly be added."

SPOTTING OF PEACHES AND CUCUMBERS, J. C. ARTHUR, D. Sc. (pp. 5–10), (illustrated).—This article contains an account of the fungus (*Cladosporium carpophilum* Thuem.) to which is due the spot disease of peaches common in Indiana and which "in some seasons causes a loss of as much as 10 per cent of the value of the crop." This fungus has hitherto only been recorded as occurring in Southern Austria. There is also an account of the closely related fungus which caused the spot disease of cucumbers at Geneva, N. Y., in 1887 (see report of New York State Experiment Station for 1887, p. 316). This disease disfigures the fruit so as to render it unsuitable for pickling, though its flavor is not affected. The name proposed for this fungus by Dr. Arthur and Mr. J. B. Ellis, of New Jersey, who has also examined it, is *Cladosporium cucumerinum*, Ellis & Arthur. No remedies for either of these fungi have yet been tried.

BULLETIN NO. 20, JANUARY, 1889.

EXPERIMENTS IN FLORICULTURE, PIERRE VAN LANDEGHEM (pp. 5–11).

Cross-fertilization of chrysanthemums.—This article contains a record of the methods used and the results attained in an attempt to produce new varieties of chrysanthemums. The results as detailed in the tables given in the bulletin are thus summarized:

(1) That fertilization by means of pollen from the same stock does not give any decided variation of color, and that crossing is an absolute necessity for the production of varieties distinct in color.

(2) That a clear, sunny day of relatively high temperature and dry atmosphere gives the best condition for this work. This is shown by the larger number of seeds obtained in the first experiment, although the same amount of pollen was used in both cases, and also by the large proportion of double flowers obtained.

Experiment in the culture of tropical ferns.—An illustrated account of the methods and apparatus used in the culture of a maiden-hair fern (*Adiantum cuneatum*) from the spores.

BULLETIN NO. 21, FEBRUARY, 1889.

RATIONAL FEEDING, C. A. WULFF, M. S. (pp. 3–16).—This bulletin was prepared in response to the many inquiries on this subject received from farmers by the Station. It contains an account of the chemical composition of feeding stuffs, tables of analyses from American and German sources, tables of feeding standards as worked out by Prof. E. von Wolff, directions for the use of these tables, and useful practical suggestions for economical feeding.

BULLETIN NO. 22, MARCH, 1889.

COMMERCIAL FERTILIZERS, H. A. HUSTON, A. C. (pp. 5–16).—This bulletin contains popular explanations of technical terms and of tables of analyses, a table of analyses of seventy-five fertilizers sold in the State, and the full text of the Indiana law for fertilizer control. The law is viewed as defective in not providing for a plan of inspection and for the chemical work necessary to its enforcement. The fertilizers on the market thus far tested have been found to agree with the analyses of the samples furnished by the manufacturers. There is, however, reason to believe that the law is evaded in the southern part of the State.

"The investigation of the needs of a given soil can only be made by experiment, and the Station is prepared to give directions for such experiments to those who desire it."

"It is estimated that 10,000 tons of fertilizers were legally sold in the State during the past year. Of this amount 2,150 tons were manufactured in the State and 7,850 tons were imported. The estimated commercial value of this is $340,000. Nearly one-half of the material sold was ground bone. It is interesting to notice that more potash is contained in the goods sold than formerly." From comparisons of amounts and composition of fertilizers applied and crops removed it is inferred that "the soils of the State are becoming reduced in fertility, and that a time is coming when much greater quantities of potash must be supplied." "Experiments conducted here during the past ten years indicate that our naturally rich soils become exhausted more rapidly than it was formerly supposed that they would."

BULLETIN NO. 23.

EXPERIMENTS WITH CORN IN 1888, W. C. LATTA, M. S. (pp. 3–12).—This article gives an account of field experiments with corn carried on at this Station during the season of 1888, and compares them with similar experiments in previous years. The description of the experiments themselves is prefaced by a weather summary for the growing season of 1888, and a brief account of the previous cropping, preparation of the soil, date of planting, size and treatment of the plats, etc. The season was so dry as to reduce the yield materially.

Early and late planting.—The earliest planting (May 1) gave the lowest yield. The difference between the second (May 11) and the third (May 21) planting was so small that it may be disregarded. Continuation of the experiments through a series of years is necessary to obtain averages which will be of practical value.

Deep and shallow plowing.—In a two years' trial the extra labor involved in deep breaking (8 inches as compared with 4½ inches) has not been justified by the increase in the yield of corn. The experiment will be continued.

Deep, medium, and shallow culture.—The depths of cultivation were one half, two-thirds, and three-fourths inch. The adjustment of the cultivator was such that there was very little breaking of corn roots even by the deepest cultivation. There was a little difference in yield in favor of the deepest cultivation, due probably to "the thicker layer of loosened soil—a more perfect mulch to conserve the scanty supply of moisture during the drought which followed." "The results thus far are not very satisfactory."

Use of different corn cultivators.—"Repetition will be necessary to reach definite conclusions."

Different rates of planting.—Results of a three years' trial with hand and with machine planting at different distances, from hill to hill and with different numbers of kernels in the hill are reported. From the tabulated results it appears that with the hand planting "the proportion of large corn is greater where the stand is thinner (*e. g.*, two kernels every 24 or 36 inches, or one kernel every 18 inches), but the medium and thicker stands" (*e. g.*, one kernel every 12 inches to kernels every 20 to 28, or three kernels every 33 inches) usually produce the larger total yield. With the machine, which in most cases dropped one kernel but sometimes two in a place, the largest yield in 1888 was obtained from the thickest stand, 10¾ inches, the largest average yield for the three years from the next to the thickest stand, 12⅛ inches from stalk to stalk.

"On comparing the two series we find that with stalks 12 to 14 inches apart, or with an equivalent stand in hills, the best yields were usually obtained. The proportions of stalk and ear did not vary materially. When the crop is grown chiefly for the grain a moderately thin stand is preferable, as it will produce larger and fewer ears, and thus save labor in gathering. If both stalk and ear are to be fed (and this should be the general rule), the thicker stands will prove more satisfactory, as the yields will not be decreased and the stalks will be eaten with less waste."

Effect of previous manuring.—A five years' trial. Gas lime, superphosphate, and horse manure were applied on different plats in 1883, and again in 1884. No manure has been used since. The immediate effect of the gas lime was injurious, and the gas lime and superphosphate have produced no material effect on the aggregate yield in five years, while the horse manure produced a marked increase, and its effects are not yet exhausted. The maximum yield in every case was in 1875, the year following the last manuring.

Comparison of varieties of corn.—Twenty-two varieties were grown with like treatment and under apparently uniform conditions. The plats, however, proved to be unequal in productive capacity, and therefore the yields are not given. A table recapitulates results, including the proportion of ears and stalks in 100 pounds of crop at the time of husking, the height to ears and to top of stalk, and the percentages of shelled corn in twenty-five ears, selected November 7 and hung in an open loft until March 9.

It is believed that Blount's Prolific, Golden Beauty, Piasa King, Speckled Dent, Chester County Mammoth, Maryland White Gourd, Golden Dent, and Chester County Gourd Seed would hardly mature here in an average season. If a late, tall, leafy variety with a small proportion of corn was desired for ensilage, Blount's Prolific, Golden Beauty, Piasa King, Speckled Dent, and Old Cabin Home would prove satisfactory. Purdue Yellow Dent, First Premium, Smedley, Pride of the North, Early Yellow, Hathoway, and Early Adams would doubtless mature every year in the north part of the State. The last-named is, however, entirely too small for Indiana. Boone County White, Duke's Early, Riley's Favorite, Leaming, and Davis's Improved would mature in favorable seasons, but would hardly be reliable north of the latitude of the Station.

Inferences.—The following are the tentative inferences drawn at the present stage of the work:

(1) Climate is the controlling influence in crop production. It frequently hinders or prevents the action of other causes. For instance, in 1887—an abnormally dry year—fertilizers, methods of preparing ground, planting, etc., were practically without effect.

(2) If the best results are to be obtained in dry seasons, it is essential to adopt such methods of preparing and cultivating the soil as will best conserve the scanty supply of moisture. The most practicable means to this end are: Drainage of lands, which have retentive subsoils; deep and thorough preparation of the ground before planting; frequent and thorough pulverization of the upper 2 or 3 inches of soil by implements that will leave the ground level and not seriously disturb the corn roots, and the frequent turning under of stable manure, sod, or green manuring crops to keep up the supply of vegetable matter in the soil.

(3) No corn cultivator is equally adapted to all soils or to all stages of growth of corn. The common corn plow I consider a very imperfect implement for either early or late cultivation, as it ridges and imperfectly pulverizes the ground. The six-shovel plow is better than the four-shovel; and with the inner pair of shovels set high and the middle and outer pairs set well down, this implement may be used to advantage early in the season to deeply stir the soil packed by the horses. For the later cultivation, the spring-tooth, gopher, or some other form of cultivator having a shallow and good pulverizing action, will be found preferable.

(4) Stable manure has had a more marked effect than commercial fertilizers on the yield of crops at the Experiment Station. Being a complete manure, it will benefit

all classes of soils that need to be enriched. It should never be wasted, and wherever it can be cheaply obtained in towns or cities its use will prove profitable.

(5) Commercial fertilizers vary greatly in their effect on the yield of crops. Before deciding on their extensive use, the different grades on the market should be tested on a small scale to determine which will give best returns.

BULLETIN NO. 24, MAY, 1889.

EXPERIMENTS ON MILK PRODUCTION, C. A. WULFF, M. S. (pp. 5–16).—The bulletin contains a "report of progress" on experiments in milk production carried on at the Station in three lines: (1) Cold *vs.* warm water for milch cows in cold weather; (2) divided milkings; (3) studies on milk secretion.

Cold vs. warm water.—Six cows divided into two lots received, the one cold, and the other, warm water. As the experiment progressed the yield of milk gradually decreased. The amount of water drunk constantly increased with the temperature of the water given. "The effect on the composition of the milk was not sufficiently definite to offer conclusive results." The amounts and composition of the food given, amounts and temperatures of the water, live weight of the animals, and yields of milk are stated in tables.

Divided milkings.—"It is very commonly known that the last milk obtained during the milking is the richest." An experiment was undertaken to get light upon the question as to whether this fact can be advantageously utilized in practice. Six cows were milked daily at 6 o'clock in the morning and evening. During each milking the milk was divided by guess into two lots as evenly as possible. The "first half" and "last half" of the milk from all the cows were put in separate vessels. Portions were analyzed which showed an average of 2.41 per cent of fat in the first half and 4.28 in the last. In other words, the percentage of fat in the milk last drawn was nearly 50 (43.6) per cent greater than in the first half. "The butter value of the second half of the milking therefore appears to be 43.6 per cent greater than the value of the first half of the same milking."

Microscopical examinations.—The character of the fat globules, as well as the proportion of fat, affects the value of the milk for butter making. In order to obtain a more complete idea of the results of dividing, samples of the morning's milk of a Jersey and a Holstein cow, both full-blooded, were divided, and the fat globules of each part examined microscopically. The globules of the second half of the milking were in general larger and more homogeneous than those of the last half. Among the conclusions are the following:

(1) Since the amount of fat can differ as much as 43.55 per cent between the first and last drawn parts of the milk during a single day, there seems to be very great economy in taking the first part of the milk for family use.

(2) When feeding to calves it is quite sufficient to give them milk from the first part drawn, and to supply the further fat necessary for keeping up the nutritive ratio by using the cheaper fat in the meal of the oil containing seeds or grains.

(3) If we can obtain milk with a more homogeneous size of fat globules, the latter will all rise in the same time; the ripening of the cream before churning will be more even, and the time required for this ripening more easily controlled.

* * * * * * *

This experiment indicates rather than proves results; but it is certainly safe to advise the farmer always to divide the milk at milking, especially since the only additional trouble required is the use of two sets of milk pails. And the results seem to render the dairyman independent of some of the greatest difficulties with which he has to contend, especially in the making of butter.

Studies on milk secretion.—This article explains the way in which the milk of the cow is secreted, and shows how this affects the practice of milking. It is illustrated by diagrams of a section of an udder and a cross-section of milk vesicles.

BULLETIN NO. 25, JUNE, 1889.

INTRODUCTION BY THE DIRECTOR (pp. 3, 4).

The connection of the Station Entomologist with the Station staff, and the resulting conditions under which this bulletin is issued, are of such a nature that a few words of explanation seem desirable.

Professor Webster is the official field agent of the Entomological Division of the United States Department of Agriculture. By a special arrangement with the Department, however, he is stationed at La Fayette, and the Station is so fortunate as to avail itself of his services as a regular member of its staff. The Department of Agriculture, however, reserves the first right of using the results of any investigations made by him; hence the material here collected as a Station bulletin has all previously appeared in official publications of the Department, either in the Annual Report of the Commissioner for 1888, just issued, or in the monthly journal issued by the Entomological Division, known as "Insect Life." Neither of these publications, however, ever reaches more than a small fraction of the farmers of our State, so it is confidently believed that the facts here presented will be received by the vast majority of recipients as wholly new.

ENTOMOLOGICAL EXPERIMENTS, F. M. WEBSTER (pp. 5–18).

Experiments in rearing the plum curculio (Contrachelus nenuphar) from plums and other fruits.—See Report of the United States Department of Agriculture for 1888, pp. 78, 79.

Notes upon the longevity of the early stages of Eburia quadrigeminata, Say.—See Insect Life, Vol. I, p. 339.

A beetle (Tenebrionides mauritanica) living in an insecticide.—See Insect Life, Vol. I, pp. 314 and 360.

The larva of the clover-stem borer (Languria mozardi, Latr.) as a gall-maker.—See Insect Life, Vol. I, p. 119.

Notes on Pteromalus puparum.—See Insect Life, Vol. I, p. 225.

Little-known enemies of the potato plant in New York (Cosmopepla carnifex and Crepidodera cucumeris).—See Insect Life, Vol. I, pp. 157, 158.

Notes on species of Bryobia infesting dwellings.—See Insect Life, Vol. I, pp. 277–279.

The grain aphis (Siphonophora avenæ).—A brief account of this insect, which has recently become very abundant in Indiana.

IOWA.

Iowa Agricultural Experiment Station.

Department of Iowa State College of Agriculture and Mechanic Arts.

Location, Ames. Director, R. P. Speer.

BULLETIN NO. 4, FEBRUARY, 1889.

WILD PLUMS, R. P. SPEER (pp. 95–98).—This is an account of practical tests with several varieties of Iowa plums to determine their usefulness for canning. "Some of the wild kinds are not inferior to the best tame plums for canning, and but little skill would be necessary to improve them in size and in other respects by cross-fertilizing the blossoms of the best kinds with pollen from the largest of the tame varieties."

A number of varieties are discussed, the quality of the fruit, certainty and uncertainty of bearing, and fitness to endure Iowa climate are compared, and explanations and suggestions of interest to fruit-growers are made. The De Soto is especially recommended, "until better varieties shall be produced by cross-fertilizing it with pollen from the Black Hawk plum or Maquoketa."

A CHEMICAL STUDY OF APPLE TWIGS, G. E. PATRICK, M. SC. (pp. 99–103).—This investigation was made at the suggestion of the director with the object of learning "whether there exist in mid-winter any differences in composition between the new growth of those varieties of apple which are hardy and those which are non-hardy in the climate of central and northern Iowa." The time for the investigation was limited, and the chemical analyses of the twigs were less detailed and complete than they would otherwise have been. The percentage of moisture, extractives, crude protein and ash and the specific gravities were determined.

Four varieties of twigs were studied, namely, Duchess of Oldenburg, Borovinca, Ben Davis, and Boiken—the two first named being regarded as hardy and the two latter being regarded as non-hardy varieties. The twigs were taken from the trees and the work done during January just passed.

The results of this short study show that of the samples examined—for no conclusions reaching beyond these can be deduced from so scant data—

(1) The tender varieties contained somewhat more of extractable matters than did the hardy.

(2) The tender varieties contained a smaller total of sugars, dextrin, and other water-soluble substances convertible into glucose by dilute acids.

(3) The tender varieties contained more free acids than did the hardy.

(4) The tender varieties contained more soluble pectins and less dextrin than did the hardy.

(5) Of extractive matters undetermined the tender varieties contained the most.

(6) Protein showed wide variations in the different samples, but not on the lines of tender and hardy. Ash was nearly the same in all.

Conclusion.—The results as a whole certainly do not negative the idea that chemical analysis may yet aid in distinguishing between hardy and tender varieties, and perhaps even lend it some slight encouragement; moreover they distinctly point out certain lines for future study.

Could the end aimed at be fully attained, so that tender and hardy varieties could be absolutely distinguished from each other by means of chemical tests, and farmer and horticulturist be saved the years of trial now so often ending in dismal failure, the gain to all classes would be inestimable.

AN INVESTIGATION OF APPLE TWIGS, B. D. HALSTED, D. SC. (pp. 104–132).—These botanical studies are cognate with the chemical studies above referred to "with a view of increasing the present knowledge of the minute structure of the twigs, including buds, of various varieties of apple trees. The investigations herein described were prosecuted during the months of December (1888) and January (1889). Primarily the investigations were carried out to determine the conditions in which the various food materials formed by the trees were stored up for future use; and in the second place to find if there were any marked differences in the amounts and qualities of these reserve food substances or any other constant differences among the varieties subjected to microscopic examination." The structure of twigs and buds and the functions of their reserve materials are explained and discussed, and a considerable number of observations with the microscope are described.

There is a manifest tendency for the concentration of reserve materials at points where they are to be used and in the order named; first the albuminoids and next the carbohydrates—first the basis of protoplasm and next the substances protoplasm must use in the building up of new tissue and in other vital processes. * * * Following upon this is the conclusion resulting from the investigations upon the apple twigs, namely, that other things remaining the same, the best-conditioned twig is the one having a sufficient amount of reserve material within easy reach, and in the best condition for the use of the plant. A well-preserved bud is therefore plump, with reserve substance in a comparatively solid condition, being firm but not woody; is well protected from the injurious effects of very sudden extreme changes of temperature, and has close at hand a sufficient amount of starch or other carbohydrate for its advantageous development.

A prime condition of hardiness is maturity, and an essential part of the growth of twigs to maturity is the storing of material in condition to be kept until spring opens.

Albuminoids and starch, which are concentrated as reserve material in the twigs as the season advances, may be taken as the test of maturity. Another test for autumn maturity in the apple seems to be found in the lignified starch-bearing cone close below the terminal bud. "'Grit' is determined as consisting of the thick-walled cells of the pith, medullary rays, and wood pith. These cells are thickest in well-matured twigs, and when well filled with starch, therefore the presence of 'grit' is an index of ripeness and the starch-storing capacity. Grittiness is therefore a good sign in the apple, but it is not safe to conclude that it can establish the rank a variety should take in any fruit-list."

"Maturity of twigs is a condition of successful wintering, and therefore the so-called hardy sorts are quite sure to finish their season's growth before autumn frosts arrive. But, under favorable conditions—similar to those which obtained last autumn—the so-called tender varieties may complete their growth and pass the winter in safety. * * * Plants seemingly equally hardy may have the vital parts very differently constructed. No matter along what line the matter has been worked out by the species, the chief point is to prepare for hard times and, having once made the preparation, keep quiet until the coast is clear for another year of growth. The inherent tendency of one introduced variety to start into growth before another, may throw it into the class called tender, while another with the same structure but differently disposed will prove hardy."

On the whole the differences which distinguish hardy from tender varieties of apple-trees are more likely to be determined by field trials than by studies of chemical constituents or cell structure, though work in both the chemical and botanical lines may bring very important results.

PROPAGATION OF TREES AND SHRUBS FROM CUTTINGS, JOHN CRAIG (pp. 133–136).—An account of the propagation of a number of varieties of forest and ornamental trees and shrubs from cuttings, with a table showing the per cent growing and the amount of growth.

SOME SUGGESTIONS CONCERNING THE CORN ROOT-WORM (DIABROTICA LONGICORNIS, SAY), PROF. HERBERT OSBORN (pp. 137–140).—Rotation of crops is recommended as a remedy.

BULLETIN NO. 5, MAY, 1889.

SORGHUM, G. E. PATRICK, M. SC. (pp. 143–160).

Two facts seem to support the idea that conditions existing in this State favor the development of sucrose in the sorghum plant. They are—

(1) Sirups made in certain localities in the State have shown themselves very prone to granulate; so much so that sirup-makers work to prevent it. The small amount of sugar thus far made in the State has nearly all been an incidental, perhaps more properly an accidental, product of the sirup industry.

The amount thus produced in 1887, without special effort or design and entirely without proper machinery, is placed by the State Secretary of Agriculture at 73,583 pounds.

In some cases a considerable amount, and of merchantable quality, has been made by a single individual. Thus Mr. C. Bozarth, a sirup-maker at Cedar Falls, reports having made in 1880 15,000 pounds, which sold for 8 cents per pound, and in 1881 5,000 pounds, which sold for 8½ cents per pound.

(2) Analyses thus far made of sorghum juices produced in the State show, on the average, a very gratifying percentage of sucrose.

State aid to this industry is therefore urged.

Results of experiments with Early Amber and Early Orange cane grown on the Station grounds by the director, and analyzed and reported by Professor Patrick, are given in detail. The results of observations on the effects of suckering are also given. These experiments will be fully discussed in a forthcoming bulletin of the Division of Chemistry of this Department. Further account of them here is therefore unnecessary.

IMPORTANT INJURIOUS INSECTS, C. P. GILLETTE, M. SC. (pp. 161–196).—This contains short accounts of the most important insect pests of Iowa, and the means for their prevention or destruction. The following are described: Cut-worms (*Noctuidæ* spp.) sod web-worm (*Crambus exsiccatus*), wire-worms (*Elateridæ* spp.), corn root-worm (*Diabrotica longicornis*), cabbage-worms (*Pieris rapæ* and *protodice*, and *Plusia brassicæ*), striped cucumber-beetle (*Diabrotica vittata*), flat-headed borer (*Crysobothris femorata*), round-headed borer (*Saperda candida*), codling moth (*Carpocapsa pomonella*), plum curculio (*Conotrachelus nenuphar*), plant-lice (*Aphididæ* spp.), red spider (*Tetranychus telarius*), cattle-lice (*Hematopinus eurysternus* and *Trichodectes scalaris*). Among the experiments with remedies reported, are the following:

For the striped cucumber-beetle.—Ashes, lime, and hellebore were used, with unsatisfactory results. Pyrethrum dissolved in water was ineffectual, but when applied dry in the early morning was a "complete success." London purple mixed with flour in the proportion of 1 to 20, and dusted over the plants, afforded a partial protection, as did "Oxide of Silicates," a patent insecticide whose chief ingredient is stated to be plaster of Paris. A few plants in a garden may be protected by covering "one end of open boxes with cheese-cloth, and setting the boxes over the hills," or "thin cloth or paper may be laid over the plants and the edges held down with clods or stones."

For plant-lice.—Kerosene emulsion (2 per cent strong) is recommended as the most useful insecticide against plant lice, if applied thoroughly.

For cattle-lice.—Kerosene and lard, kerosene emulsion (8 per cent), potato water, and pyrethrum were successfully used.

Experiments with pyrethrum (pp. 190–193).—This is an account of tests made "for the purpose of proving or disproving" whether it is necessary to keep "this powder in closed vessels in order to retain its strength," and whether good results can be obtained by making a decoction of the powder in boiling water.

> As a result of my experiments it seems safe to conclude, at least until more careful and exhaustive experiments prove to the contrary, that when it is desired to use pyrethrum in water without waiting twenty-four hours it can be prepared in boiling water (in which case I would advise boiling for five or ten minutes) and as good results obtained as with the cold-water extraction, and second, although it is always advisable to keep the powder in tight receptacles it does not seem possible that the powder loses its strength very rapidly when exposed to the air.

Potato-water.—An account of the successful use of strong potato-water as an insecticide for plant-lice.

> The parings were chosen for the experiments upon the supposition that if there was any insecticidal property in the potato it would be in the skin, but perhaps the paste formed by the starch of the potato in water may have clogged the spiracles and done the killing instead.

KANSAS.

Kansas Agricultural Experiment Station.
Department of Kansas State Agricultural College.
Location, Manhattan. Director, E. M. Shelton, M. Sc.

BULLETIN NO. 6, JUNE, 1889.

SILOS AND SILAGE, E. M. SHELTON, M. SC. (pp. 3–16).—This bulletin discusses the objections to corn fodder on account of the cost of handling and losses in fodder making and feeding, and the advantages of silos and silage for Kansas. "Every practical man familiar with the facts understands that corn fodder in Kansas is a very different thing from the article of the same name raised in New England and the Middle States." The proportion of leaves and blade on Kansas corn is much less than in the case of the varieties grown in the Eastern and Middle States. In Kansas the ripening period is very brief, allowing very little time to cut and shock the corn. The tying and shocking of the bundles of fodder at husking time is a difficult task, owing to the dry and brittle condition of the stalks and to their bulk. A great amount of fodder is unavoidably wasted in this process and its coarse and bulky character makes the fodder difficult to store. The cost of cutting up the corn and of husking from the shocks must also be considered.

For these reasons chiefly, and because of the cost of cutting up the corn and the added cost of husking from the shocks, we have ceased upon the college farm to attempt further to grow corn and fodder in the same field. The same facts have compelled us to look to the silo as a means of utilizing the wealth of vegetation which is otherwise largely wasted in our corn-fields.

Waste of fodder in feeding.—The experiments of 1887 and 1888 are epitomized in a table which gives the period of each experiment, number of cows fed, daily and total feed, total waste, length of cut of fodder, per cent of waste, and the quality of the fodder. The author is convinced that the chief value of cutting fodder lies in the fact that the chopped fodder can be more conveniently handled.

The addition of meal to the cut fodder diminished the waste greatly without a doubt, although it may well be questionable whether cattle are benefited by consuming a large amount of indigestible, woody fiber to which they have been tempted by a very small amount of adhering meal.

The striking fact is that even with the very excellent fodder used in this experiment, and fed as it was in a tight manger, the cattle rejected 31 per cent of all placed before them. Consider for a moment what would likely—certainly, I may say—be the case with ordinary, coarse fodder fed on the ground in the field or yard and often necessarily in the mud!

The loss of corn in fodder making.—The experiments of last season (see First Annual Report of Kansas Station, p. 42) indicate that the loss of corn when cut even slightly green is very great.

To still further study the question of the best time to cut standing corn in order to secure the largest yield of corn and fodder, careful cuttings and weighings were made of corn at different stages of ripeness.

> We find, * * * in nearly every case, that adjacent rows, cut at intervals of seven to twenty days, show variations, with only two or three exceptions, in seventy-odd cases almost exactly proportionate to the difference in the time of cutting; the largest yield of the best quality of corn going with the row cut latest. Indeed, we are plainly taught here that corn continues to improve in weight until the very last—after the blades of the plant have been dried up, and quite likely blown away, and seemingly until the juices of the stalks have been completely sucked up. It is hard to resist the conviction that this can not be a mere coincidence; that, in short, these figures point to a real principle in the growth of the crop which the farmer can not afford to ignore. * * * Considering then all the facts—the great labor of husking corn from the shock as compared with "picking" it from the standing stalks, the great difficulty in tying, hauling, and stacking, or otherwise securing the fodder crop, and the great waste of fodder in the field and ultimate loss in feeding (which we have demonstrated time and again to amount to 20 to 60 per cent of the stalks)—it is perfectly clear to me that we must raise corn for corn, with no thought of fodder, and corn again which has no higher purpose than the production of fodder. We must, in short, have two corn-fields on every farm, receiving radically different treatment, to correspond with the different purposes for which they are cultivated.
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> This seems to me to state with sufficient fullness the argument against the attempt to get grain and fodder from the same field. The great Kansas staples, corn and sorghum, are unsurpassed fodder-plants when grown and harvested with the single object of making "hay." I have come to think, after three years of careful experiment with the silo upon the college farm, that it is a necessary part of the machinery of the corn-field. The argument for this view is given in what follows.

Special value of the silo to Kansas.—Corn and sorghum are, and will probably remain, for Kansas farmers the principal sources of stock food. They will yield two or three times as much nutritive material as timothy, clover, orchard grass, or millet on the same area. They may be harvested, cured, and handled with less cost and less waste. A rich crop may be grown for the silo and preserved despite either drouth or grasshoppers.

In reply to the objection often urged against ensilage, on the ground of its expensiveness as compared with fodder-making in the field, the bulletin urges that while in either case the corn must be cut up and hauled to the barn or feed place, the silaging saves the husking, hauling, shelling, and grinding of the corn. The overwhelming argument for the silo is that corn and sorghum may by this means be cut, cured, and fed in such time and manner as to give the farmer all of the value that there is in them.

Location, size, and construction of silo.—A silo erected inside a barn from the floor to the basement or cellar to the purlin plates is advocated. A silo located in a dry bank or bluff-side would be advantageously situated if the ensilage could be withdrawn at the lowest point of the silo. A silo with a cellar is wholly inadmissible. The experience with stone silos at this Station has been most disastrous, about 50 per cent of the ensilage having been lost.

The silo should be so located that the feeding from it can be done with the least labor.

A silo larger in superficial area than 30 by 15 feet is not recommended. If larger it would be well to divide it by one or more cross partitions. With a good quality of ensilage for herds, made up of large and small animals, 1 cubic foot per head per day is recommended as a safe basis for an estimate of the size.

Directions are given for the construction of a silo and illustrated by a cut. The best and cheapest material for the floor is said to be common clay. The cost of construction in Kansas will be about $2 per ton of contents.

Silage materials.—The coarse-growing fodder plants, like corn and sorghum, are sure, in Kansas and generally throughout the West, to be the principal, if not only, silage crops. * * * The common dent varieties of corn and the medium-growing saccharine and non-saccharine sorghums are all excellent silage materials. We are strongly of the opinion that in time it will be demonstrated that sorghum is greatly superior to corn as a silage material. We can recommend Late Orange, Goose Neck, and particularly Golden Rod, as being especially valuable for silaging. The sorghums have this great advantage over corn: they are less liable to damage by insects, and they remain green far into the fall, usually until cut by frosts, so that the work of filling the silo may be carried on long after the corn plant has ripened its crop and the stalks have become worthless.

Growing the silage crop.—So far as the corn crop is concerned the tendency in recent years has been strongly in the direction of thinner planting for silage. * * *

We plant ensilage corn in drills 3½ feet apart, with plants occupying in the rows 8 to 12 inches of space. With sorghum designed for the silo we should plant in drills 3½ feet apart, and grow individual plants in the rows at intervals of 6 to 10 inches. Upon good soil and with fair treatment corn raised as above will yield 12 to 16 tons of silage per acre, while the yield of sorghum will often reach 20 tons.

Harvesting the crop.—The tendency has in recent years been markedly towards harvesting corn designed for the silo at an advanced stage of ripeness.

In Kansas it will not be safe to follow Eastern practices in this respect. Here the intense heats and other special climatic influences push the corn crop, when once on the down grade towards ripeness, at a constantly accelerating speed, so that often only a few hours separate the grain which is only "glazed," and that which is ripe to flintiness, and dead and dry in leaf, stem, and seed. Moreover, after the corn plant begins to dry up and "fire," the winds act upon the blades and tender parts of the plant most wastefully.

The simplest, and on most accounts best, method of harvesting corn for the silo is the common plan of cutting the corn with the corn-knife and gathering it in armfuls, carrying each armful as fast as cut directly to the wagon rack.

Filling and emptying the silo.—For practical men this fact remains: The filling may be slow or rapid as is most convenient, but after the silo has been sealed up, it should not be disturbed until the silage is wanted for feeding. It is preferable to feed from the top so that more or less of the entire surface can be fed every day. As ensilage moulds quite rapidly, exposure to the atmosphere for a number of days may result in considerable damage.

Station experiments with silage, 1888–89.—The results of experiments with 115 tons of silage are clearly and concisely summarized thus:

Eight and one-half acres of corn gave 98.8 tons of silage.

Eight and one-half acres of corn gave an average yield of 11.83 tons per acre.

The maximum yield of a measured acre of this field was 16.1 tons.

The 115 tons of silage fed by us in the winter of 1888–89 carried fifty-six head of cattle one hundred and twenty-three days.

An average daily feed—with small-grain ration—of 34 pounds equal 1 cubic foot of silage.

Of the 80 tons placed in silo No. 2, 10,347 pounds, equals 6.47 per cent, spoiled.*

Of the 80 tons placed in silo No. 2, 1,296 pounds, less than 1 per cent, were rejected † by the cattle.

Of the 80 tons placed in silo No. 2, 7 per cent was lost by evaporation.

The actual cost of cutting up the corn, hauling it 50 rods to the silo, and stowing it therein, was 62 cents ‡ per ton.

Assuming that 1 acre of corn produces 24,000 pounds of silage, each animal consuming 34 pounds daily, and deducting 10 per cent for waste, we have it that 1 acre of corn put in the form of silage will carry, with small-grain ration, three cattle during one hundred and ninety-five days, with eighty days to spare.

That best results will be had when silage is fed with hay or other dry fodder, we have no doubt.

Silage, of itself, is not a sufficient food where much is expected of cattle.

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* This loss was chiefly caused by the yielding of the silo walls.

† Due almost wholly to overfeeding.

‡ This includes fuel for engine, but no charge is made for use of machinery. I have no doubt that this expense might be greatly reduced.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

JANUARY 1 TO AUGUST 15, 1889.

Annual Report of the Department for 1888.

OFFICE OF EXPERIMENT STATIONS:

- Doc. No. 1, Circular No. 1.—List of Agricultural Experiment Stations in the United States, with addresses; issued February 1, 1889.
- Doc. No. 2, Circular No. 2.—Regarding meeting of Eastern and Southern Stations to discuss co-operative field experiments; issued January 31, 1889.
- Doc. No. 3, Circular No. 3.—Regarding originators of fruits, etc.; issued February 6, 1889.
- Doc. No. 4, Circular No. 4.—Memorandum for Station Reports; issued February 12, 1889.
- *Doc. No. 5, Experiment Station Bulletin No. 1.—Organization of the Agricultural Experiment Stations in the United States; issued February, 1889.
- Doc. No. 6, Circular No. 5.—Call for meeting of stations for discussion of co-operative experiments; issued February 25, 1889.
- Doc. No. 7, Circular No. 6.—List of originators of fruits, vegetables, etc., in the United States; issued March 8, 1889.
- *Doc. No. 8, Circular No. 7.—Co-operative field experiments with fertilizers; issued March, 1889. This contains the report of the conference of representatives of stations regarding co-operative field experiments with fertilizers, directions and explanations for soil tests with fertilizers, and suggestions for further experiments.
- *Doc. No. 9, Circular No. 8.—Explanations and directions for soil tests with fertilizers; issued March, 1889. This is intended for the use of farmers experimenting under the direction of the stations. It is included in Circular No. 8, but was printed separately for convenience.
- Doc. No. 10.—Letter of advice concerning blank forms for reports of horticulturists; issued April 15, 1889.
- Doc. No. 11.—Form 1, Horticulturists' blank for vegetables; issued April 15, 1889.
- Doc. No. 12.—Form 2, Horticulturists' blank for fruits; issued April 15, 1889.
- Doc. No. 13.—Form 3, Blank for reports of horticulturists; issued April 15, 1889.
- Doc. No. 14, Circular No. 9.—Memorandum of information for a report on Farmers' Institutes in United States; issued May 10, 1889.
- *Doc. No. 16, Farmers' Bulletin No. 1.—The What and Why of Agricultural Experiment Stations; issued June, 1889.
- Doc. No. 18, Circular No. 10.—Asking for accounts of special work in horticulture; issued July 1, 1889.
- *Doc. No. 15, Miscellaneous Bulletin No. 1.—Proceedings of Association of American Agricultural Colleges and Experiment Stations at Knoxville, Tenn., January, 1889.

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*The asterisk indicates that the document is sent on application. The other documents of this Office are issued in very limited editions for special purposes and are not of general interest.

Bureau of Animal Industry:

Hog Cholera: History, Nature, and Treatment.
Epizootic Diseases among Swine.

Division of Statistics:

Report No. 59, new series, January and February, 1889.—Numbers and Values of Farm Animals.
Report No. 60, new series, March, 1889.—Distribution and Consumption of Corn and Wheat.
Report No. 61, new series, April, 1889.—Condition of Winter Grain and Farm Animals.
Report No. 62, new series, May, 1889.—Condition of Winter Grain and Progress of Cotton Planting.
Report No. 63, new series, June, 1889.—Acreage of Wheat and Cotton.
Report No. 64, new series, July, 1889.—Area of Corn, Potatoes and Tobacco.
Report No. 65, new series, August, 1889.—Condition of Growing Crops.
Album of Agricultural Statistics of the United States.

Division of Entomology:

Periodical Bulletin, vol. 1, Nos. 7–12 and vol. 2, No. 1.—Insect Life.

Division of Chemistry:

Bulletin No. 13, Part IV.—Lard and Lard Adulterations.
Bulletin No. 20.—Experiments in the Manufacture of Sugar from Sorghum.
Bulletin No. 21.—Experiments in the Manufacture of Sugar by Diffusion.

Division of Botany:

Bulletin No. 8.—Record of Some of the Work of the Division.

Section of Vegetable Pathology:

Quarterly Bulletin, March, 1889, vol. 5, No. 1.—Journal of Mycology.
Bulletin No. 9.—Peach Yellows.
Bulletin No. 10.—Downy Mildew and Black Rot of the Grape-Vine.

Division of Ornithology and Mammalogy:

Bulletin No. 1.—English Sparrow in North America.

Division of Forestry:

Bulletin No. 2.—Forest Conditions of the Rocky Mountains (reprint).
Bulletin No. 3.—The use of Metal Track on Railways as a Substitute for Wooden Ties.

LIST OF STATION BULLETINS OF 1889, RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

JANUARY 1 TO AUGUST 15, 1889.

ALABAMA.

Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama:

Bulletin No. 3, new series, January, 1889.—Report of Experiments, Analyses of Fertilizers, etc.

Bulletin No. 4, new series, February, 1889.—Strawberry, Grape, and Raspberry Culture.

Bulletin No. 5, April, 1889.—Cotton, Pigs, Cattle, Analyses, Meteorology.

Canebrake Agricultural Experiment Station:

Bulletin No. 3, January, 1889.—Corn, Forage Crops, Drainage.

Bulletin No. 4, April, 1889.—Experiments with Cotton, Meteorology.

ARKANSAS.

Arkansas Agricultural Experiment Station:

Bulletin No. 8, April, 1889.—Spaying of Cattle.

Bulletin No. 9, May, 1889.—Cotton-Seed Hulls for Fattening Cattle.

Bulletin No. 10, June, 1889.—Entomological Notes, Meteorological Summary, and Chemical Fertilizers.

CALIFORNIA.

Agricultural Experiment Station of the University of California:

Bulletin No. 82, June, 1889.—The Lakes of the San Joaquin Valley.

COLORADO.

Agricultural Experiment Station of Colorado:

Bulletin No. 6, January, 1889.—Notes on Insects and Insecticides.

Bulletin No. 7, April, 1889.—Potatoes and Sugar Beets.

Bulletin No. 8, July, 1889.—Alfalfa: Its Growth, Composition, Digestibility, etc.

CONNECTICUT.

The Connecticut Agricultural Experiment Station:

Bulletin No. 96, January, 1889.—On the Valuation of Feeding Stuffs; Analyses of Feeding Stuffs.

Bulletin No. 97, April, 1889.—Fungous Diseases of Plants; Fertilizer Analyses.

Bulletin No. 98, June, 1889.—Home-mixed Fertilizers.

Bulletin No. 99, June, 1889.—Fertilizer Analyses.

Storrs School Agricultural Experiment Station:

Bulletin No. 3, February, 1889.—Roots of Plants as Manure.

Bulletin No. 4, July, 1889.—Meteorological Observations; Bacteria in Milk and its Products.

DAKOTA.

DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 9, January, 1889.—Department of Agriculture. Corn.

Bulletin No. 10, February, 1889.—Department of Forestry, Horticulture, and Botany. The Germination of Frosted Grain.

Bulletin No. 11, March, 1889.—Department of Agriculture. Small Grain (Wheat, Oats, and Barley).

Bulletin No. 12, April, 1889.—Department of Forestry, Horticulture, and Botany. Forestry, Trees in the College Lawn, The Forest Tree Nursery.

Bulletin No. 13, April, 1889.—Department of Entomology. Notes on Various Insects and Remedies.

Bulletin No. 14, April, 1889.—Department of Chemistry. The Sugar Beet.

DELAWARE.

THE DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 4, May, 1889.—Injurious Insects, their Identification and Extermination.

Bulletin No. 5, June, 1889.—The Inspection of Seed and of Stock Feed in Delaware.

FLORIDA.

AGRICULTURAL EXPERIMENT STATION OF FLORIDA:

Bulletin No. 5, April, 1889.—Analysis of Fertilizers.

GEORGIA.

GEORGIA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 2, January, 1889.—Ash Analyses of Native Woods, Experiments with Phosphates and Kainit on Cotton, etc.

Bulletin No. 3, April, 1889.—Notes on Various Insects and Remedies, Ash Analyses of Native Woods, etc.

Bulletin No. 4, July, 1889.—Analyses of Cattle Food.

ILLINOIS.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS:

Bulletin No. 4, February, 1889.—Field Experiments with Corn, 1888.

Bulletin No. 5, May, 1889.—Grasses and Clovers: Effect of Ripeness on Yield and Composition.

INDIANA.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Bulletin No. 18, January, 1889.—Experiments with Vegetables.

Bulletin No. 19, January, 1889.—Spotting of Peaches and Cucumbers.

Bulletin No. 20, January, 1889.—1. Experiments in Cross-Fertilization. 2. The Culture of Tropical Ferns.

Bulletin No. 21, February, 1889.—Rational Feeding.

Bulletin No. 22, March, 1889.—Commercial Fertilizers.

Bulletin No. 23, April, 1889.—Experiments with Corn.

Bulletin No. 24, May, 1889.—Experiments on Milk Production. 1. Cold *vs.* Warm Water. 2. Divided Milkings. 3. Studies on Milk Secretion.

Bulletin No. 25, June, 1889.—Entomological Experiments.

Bulletin No. 26, July, 1889.—Wheat Rust.

IOWA.

IOWA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 4, February, 1889.—1. Wild Plums. 2. A Chemical Study of Apple Twigs. 3. An Investigation of Apple Twigs. 4. Propagation of Trees and Shrubs from Cuttings. 5. Some Suggestions concerning the Corn Root-Worm.

IOWA AGRICULTURAL EXPERIMENT STATION—Continued.

Bulletin No. 5, May, 1889.—1. Sorghum. 2. Injurious Insects. Preparation of Insecticides. Experiments with Pyrethrum. Apparatus for applying Insecticides.

KANSAS.

KANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 6, June, 1889.—Silos and Silage.

KENTUCKY.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 17, February, 1889.—Corn Experiments.

Bulletin No. 18, April, 1889.—1. Hemp Experiments. 2. Notes on the Treatment of an Old Apple Orchard.

Bulletin No. 19, May, 1889.—Experiments in Pig-Feeding.

Bulletin No. 20, July, 1889.—Commercial Fertilizers.

LOUISIANA.

SUGAR EXPERIMENT STATION:

Bulletin No. 20, January, 1889.—Sugar-Cane.

STATE EXPERIMENT STATION:

Bulletin No. 21.—Report of the Station for 1888.

Bulletin No. 22.—March, 1889. Annual Report of the Station.

SUGAR EXPERIMENT STATION:

Bulletin No. 23.—Sugar-Cane: Laboratory and Sugar-House Results. Diffusion Process.

MASSACHUSETTS.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 32, February, 1889.—Record of Cows used in Feeding Experiments. Analysis of Feeding Stuffs.

Bulletin No. 33, March, 1889.—On Commercial Fertilizers. Trade Values, and Analyses.

Bulletin No. 34, June, 1889.—Outlines of Work carried on at the State Agricultural Experiment Station during the present Season.

Circulars—April, May, and July, 1889. Analyses of Commercial Fertilizers.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Bulletin No. 3, January, 1889.—Tuberculosis.

Bulletin No. 4, April, 1889.—Experiments in Heating Greenhouses, etc.

Bulletin No. 5, July, 1889.—Household Pests—The Buffalo Carpet Beetle, etc.

MICHIGAN.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:

Bulletin No. 43, January, 1889.—Weather Service Department; Annual Report of Director, and the Rain-fall Charts of Michigan.

Bulletin No. 44, January, 1889.—Department of Practical Agriculture; Feeding Steers of Different Breeds.

Bulletin No. 45, March, 1889.—Department of Botany and Forestry; Why not Plant a Grove?

Bulletin No. 46, March, 1889.—Department of Practical Agriculture; Potatoes, Roots, Fertilizers, and Oats.

Bulletin No. 47, April, 1889.—Department of Practical Agriculture; Silos and Ensilage.

Bulletin No. 48, April, 1889.—Horticultural Department; (1) Potatoes, (2) Kale, (3) Experiments with Squashes, (4) Tomatoes.

Bulletin No. 49, May, 1889.—Department of Chemistry; Chemical Composition of Cornstalks, Hay, and Screenings.

Bulletin No. 50, June, 1889.—Zoological Department; the Grain Plant-louse.

Bulletin No. 51, July, 1889.—Zoological Department; Enemies of the Wheat Aphis.

MINNESOTA.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA:

Bulletin No. 5, January, 1889.—Agriculture, Horticulture, Botany.

Bulletin No. 6, February, 1889.—Experiments with Frosted, Rusted, and Stack-burned Wheat.

Bulletin No. 7, April, 1889.—Soil Temperatures. Comparison of Varieties of Corn for Ensilage, etc.

MISSISSIPPI.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 6, June, 1889.—Charbon.

Bulletin No. 7, June, 1889.—Hay Presses.

MISSOURI.

MISSOURI AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 5, February, 1889.—Soil, Weather, Field Trials with Corn.

Bulletin No. 6.—Experiments on Seed Germination, Pea Weevil, and Apples.

NEBRASKA.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:

Bulletin No. 5, January, 1889.—Vol. 1., Article 3. On Certain Injurious Insects of the Year 1888.

Bulletin No. 6, March, 1889.—Report of Progress. Field Experiments and Meteorological Record for 1888.

Bulletins Nos. 7, 8, 9, 10, June, 1889.—Original Investigations of Cattle Diseases in Nebraska, 1886–1888.

NEW HAMPSHIRE.

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 5, March, 1889.—Fertilizers and Fertilizing Materials.

Bulletin No. 6, April, 1889.—Experiments with Fertilizers.

Bulletin No. 7, May, 1889.—Test of Dairy Apparatus.

NEW JERSEY.

NEW JERSEY STATE AND COLLEGE AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 52, March 20, 1889.—What are the worst Weeds of New Jersey?

Bulletin No. 53, March 26, 1889.—Prices of Nitrogen, Phosphoric Acid, and Potash.

Bulletin No. 54, March 27, 1889.—Potash as a Fertilizer.

Bulletin No. 55, March 28, 1889.—Entomological Suggestions and Inquiries.

NEW YORK.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 5, April, 1889.—1. On the Production of Lean Meat in Mature Animals. 2. Does Heating Milk Affect the Quality or Quantity of Butter?

Bulletin No. 6, June, 1889.—1. On the Determination of Hygroscopic Water in Air-dried Fodders. 2. The Determination of Nitrogen by the Azotometric Treatment of the Solution resulting from the Kjeldahl Digestion. 3. Fodders and Feeding Stuffs.

Bulletin No. 7, July, 1889.—On the Influences of Certain Conditions upon the Sprouting of Seeds.

NORTH CAROLINA.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 61, December, 1888–January, 1889.—Composts, Formulas, Analyses, and Value.

Bulletin No. 61½, February, 1889.—Fertilizer Analyses.

Bulletin No. 62, February, 1889.—Fertilizer Analyses and the Fertilizer Control, Season of 1889.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION—Continued.

Bulletin No. 62½, second edition, March, 1889.—Fertilizer Analyses and the Fertilizer Control.

Bulletin No. 63, June, 1889.—1. Test of Seeds. 2. Rust on Wheat and Cotton. 3. Laboratory Notes.

OHIO.

OHIO AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 8, second series, vol. 2, No. 1, March, 1889.—1. Practical Remedies for some Ohio Insects. 2. Insecticides and their Application. 3. Methods of Collecting, Preserving, and Studying Insects.

Bulletin No. 9, second series, vol. 2, April and May, 1889, article 4.—Colic of Horses.

OREGON.

OREGON EXPERIMENT STATION:

Bulletin No. 2, January, 1889.—Horticultural; Preparation and Notes on Proposed Work.

PENNSYLVANIA.

THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 6, January, 1889.—Tests of Varieties; Wheat, Oats, Barley, Potatoes, Forage Crops, etc.

Bulletin No. 7, April, 1889.—Tests of Varieties of Field Corn. Analyses and Valuation of Fertilizers.

SOUTH CAROLINA.

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 4, new series, January, 1889.—Entomology. Notes on Insects and Remedies.

Bulletin No. 5, new series 2, April, 1889.—Oats and Wheat.

TENNESSEE.

TENNESSEE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 1, vol. 2, January, 1889.—Notes on Fertilizers and Fertilizing Materials.

Bulletin No. 2, vol. 2, April, 1889.—Diseases of the Irish Potato.

Bulletin No. 3, vol. 2, July, 1889.—Cotton-seed Hulls and Meal for Live Stock.

TEXAS.

TEXAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 5, March, 1889.—Creameries in Texas.

Bulletin No. 6, June, 1889.—Feeding Experiment.

Feeding Experiment; extract from Bulletin No. 6, June, 1889.

VERMONT.

VERMONT STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 14, March, 1889.—Analysis of Fertilizers licensed for sale in the State of Vermont, for the year 1889.

WEST VIRGINIA.

WEST VIRGINIA EXPERIMENT STATION:

Bulletin No. 4, March, 1889.—The Creamery Industry, its Adaptability to West Virginia.

WISCONSIN.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN:

Bulletin No. 18, January, 1889.—The Constitution of Milk and some of the Conditions which affect the Separation of Cream.

Bulletin No. 19, April, 1889.—Notes on Ensilage.

Bulletin No. 20, July, 1889.—Noxious Weeds of Wisconsin.

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TABLE OF CONTENTS.

Page.
Editorial notes 57
The third annual convention of the Association of American Agricultural Colleges and Experiment Stations 57
Abstracts of Station Bulletins, January–June, 1889, Part II 61

KENTUCKY:

Kentucky Agricultural Experiment Station 61
Bulletin No. 17, February, 1889 61
Field experiments with corn, M. A. Scovell, M. S., and A. M. Peter, M. S 61
Effects of leading elements of plant food in various combinations on corn 61
Financial results from the use of various fertilizers on corn 61
Effect of barnyard manure as compared with that of the leading ingredients of commercial fertilizers in various combinations 62
Effects of copperas (sulphate of iron) on corn 62
Tobacco stems as a fertilizer for corn 62
The relation of fertilizers to shrinkage and to proportion of cob to kernel 62
Relation of amounts of phosphoric acid, nitrogen and potash in the fertilizers to amounts of the same ingredients taken up by the crop 62
Bulletin No. 18, April, 1889 62
Hemp experiments 62
Notes on the treatment of an old apple orchard 63
Bulletin No. 19, May, 1889 63
Experiments in pig-feeding, J. H. Connell, B. S 63

LOUISIANA:

Sugar, State and North Louisiana Experiment Stations 63
Bulletin No. 20 (Sugar Station), January, 1889 63
Field experiments on sugar-cane 63
Germination questions 63
Stalks of cane kept for planting 64
Number of stalks of cane to plant—Plant *vs.* stubble cane for seed 64
Suckering 64
Distance between cane rows 65
Varieties of cane 65

LOUISIANA—Continued. Page.

Sugar, State and North Louisiana Experiment Stations—Continued.

Bulletin No. 20, etc.—Continued.

Field experiments on sugar-cane—Continued.

Effects of fertilizers on sugar-cane 65

Potassic fertilizers 65

Phosphoric acid fertilizers 66

Experiments with common commercial fertilizers 66

Tiled *vs.* untiled land 66

Effect of turning under and of removing pea-vines 67

Effects of nitrogenous fertilizers on cane 67

Effects of various special fertilizers on cane 68

Effects of different mixtures of cotton-seed meal and acid phosphate 68

Summary of results 68

Analyses of fertilizers 69

Meteorology 69

Bulletin No. 21 (State Station), January, 1889 69

Report of State Experiment Station for 1888 69

Garden and orchard 69

Forage plants 69

Small grains, grasses, and clovers 69

Experiments with corn 69

Test of eighteen varieties 70

Fertilizers for corn 70

Experiments with cotton 70

Experiment in rotation of crops 70

Bulletin No. 22 (North Louisiana Station), January, 1889 70

Annual Report of the North Louisiana Experiment Station 70

Orchard and vineyard 71

Grasses and clovers 71

The vegetable garden of the station 71

Field experiments with cotton 71

Effects of fertilizers on cotton 71

Distance apart of rows 72

Distance apart of the plants in row 72

Test of varieties 72

Field experiments with corn 72

Manurial requirements 72

Proper distances between rows 72

Yield with late planting and effects of pulling off leaves for fodder 72

Test of fourteen varieties of corn 72

Forage crops 72

Bulletin No. 23 (Sugar Station), 1889 73

Diffusion of sugar cane 73

MAINE:

Maine State College Agricultural Experiment Station 73

Bulletin No. 1 (second series), May, 1889 73

Partial statement of analyses of commercial fertilizers for 1889, W. H. Jordan, M. S 73

Bulletin No. 2 (second series) 73

The apple maggot (*Trypeta pomonella*, Walsh), F. L. Harvey, M. S 73

The potato rot (*Phytophthora infestans*), F. L. Harvey, M. S 74

MARYLAND:

Page.
- **Maryland Agricultural Experiment Station** 74
  - Bulletin No. 4, March, 1889 74
    - Experiment orchard, W. H. Bishop, B. S. 74
  - Bulletin No. 5, June, 1889 75
    - Horticultural department and field experiments, H. E. Alvord, C. E. 75
      - Introductory notes 75
      - Meteorological notes 75
      - Schedule of field experiments in progress at the station, season of 1889 75
        - In agricultural department 75
        - In horticultural department 76

MASSACHUSETTS:

- **Massachusetts State Agricultural Experiment Station** 77
  - Bulletin No. 32, February, 1889 77
    - Meteorological summary 77
    - Record of feeding experiments with twelve cows, C. A. Goessmann, Ph. D. 77
      - Summary of financial record 78
    - Analyses of fodder materials, C. A. Goessmann, Ph. D. 79
  - Bulletin No. 33, March, 1889 79
    - On commercial fertilizers, C. A. Goessmann, Ph. D. 79
      - Analyses 80
      - Instructions to manufacturers, importers, agents, and sellers of commercial fertilizers or materials used for manurial purposes in Massachusetts 80
  - Circulars, April and May, 1889 80
    - Analyses of commercial fertilizers, C. A. Goessmann, Ph. D. 80
  - Bulletin No. 34, June, 1889 80
    - Meteorological summary 80
    - Outline of the work of the present season, C. A. Goessmann, Ph. D. 80
    - Department of vegetable physiology, J. E. Humphrey, S. B. 81
    - Creamery record during 1887-88, C. A. Goessmann, Ph. D. 81
    - Commercial fertilizers, C. A. Goessmann, Ph. D. 82
- **Hatch Experiment Station of the Massachusetts Agricultural College** 82
  - Bulletin No. 3, January, 1889 82
    - Tuberculosis, C. H. Fernald, Ph. D. 82
  - Bulletin No. 4, April, 1889 82
    - Division of horticulture, S. T. Maynard, B. S. 82
      - Experiments in heating greenhouses; steam heat *vs.* hot water 82
      - Greenhouse walls 83
      - Experiment on glazing of greenhouses 83
      - Evaporated sulphur as a remedy for mildews and insects in greenhouses 83
      - Growing lettuce under glass 83
      - The plum wart (*Sphæria morbosa*) 83
      - Tests of new varieties of vegetables 84
      - List of fruits grown at the station 84

MICHIGAN:

- **Experiment Station of Michigan Agricultural College** 84
  - Bulletin No. 43 (College), January, 1889 84
    - Weather service department; annual report of the director for 1888, and the rainfall charts of Michigan, N. B. Conger 84

MICHIGAN—Continued.

Page.

Experiment Station of Michigan Agricultural College—Continued.

Bulletin No. 44 (Station), January, 1889 ---- 84
  Feeding steers of different breeds, S. Johnson, M. S ---- 84
Bulletin No. 45 (College), March, 1889 ---- 86
  Why not plant a grove? W. J. Beal, Ph. D ---- 86
Bulletin No. 46 (Station), March, 1889 ---- 86
  Potatoes, roots, effects of fertilizers on potatoes, and tests of varieties of oats and barley, S. Johnson, M. S., and H. T. French, B. S ---- 86
    Potatoes ---- 86
      Tests of varieties ---- 86
      Results with different amounts of seed ---- 86
      Effects of fertilizers ---- 87
    Roots ---- 87
      Tests of varieties of carrots, sugar beets, mangels, and ruta-bagas ---- 87
    Oats and barley, tests of varieties ---- 87
Bulletin No. 47 (Station), April, 1889 ---- 87
  Silos and silage, S. Johnson, M. S ---- 87
    Seven years' experience with silos and silage ---- 87
    Views of Michigan farmers on silage ---- 88
    Experiment with silage *vs.* corn harvested in the ordinary way ---- 88
    Corn, test of varieties to determine their value for silage ---- 88
    Forage plants ---- 89
Bulletin No. 48 (Station), April, 1889 ---- 89
  Horticultural department—Potatoes, kale, squashes and tomatoes, L. R. Taft, M. S ---- 89
    Potatoes ---- 89
    Kale ---- 89
    Cross-fertilization of squashes ---- 89
    Tomatoes ---- 89
      Varieties recommended for planting ---- 89
      Effect of using seeds from first ripe fruits ---- 90
Bulletin No. 49 (Station), May, 1889 ---- 90
  Chemical composition of corn stalks, hay, and screenings, R. C. Kedzie, M. D ---- 90
    Corn stalks and silage at different periods of growth ---- 90
    Marsh hay and wheat screenings ---- 90
Bulletin No. 50 (Station), June, 1889 ---- 91
  The grain plant-louse, A. J. Cook, M. S ---- 91

MINNESOTA:

Agricultural Experiment Station of the University of Minnesota ---- 91
Bulletin No. 5, January, 1889 ---- 91
  Introduction, E. D. Porter, Ph. D ---- 91
  Corn, its habits of root growth, methods of planting and cultivating, notes on ears and stools or suckers, W. M. Hays, B. S. A ---- 91
    Habits of root growth ---- 91
      Application of the facts to the cultivation of corn ---- 92
    Field tests of deep *vs.* shallow culture ---- 92
    Tests of root pruning and hilling ---- 92
    General conclusions and suggestions ---- 93
    Branching of the corn plant ---- 93

Page.

MINNESOTA—Continued.

Agricultural Experiment Station of the University of Minnesota—Continued.

Bulletin No. 5, etc.—Continued.

Growth of Russian willows and poplars from hard-wood cuttings, S. B. Green, B. S. 93
Native plums, S. B. Green, B. S. 94
Tests of varieties of cabbage, S. B. Green, B. S. 94
Experiments in potato culture, C. Poumeroulie 94
Frosted and rusted wheat, Otto Lugger, Ph. D. 94
Freezing of plants 94
Rusting of wheat 94
Bulletin No. 6, February, 1889 94
Notes on the effects of frost and rust on the germination of wheat, E. D. Porter, Ph. D. 94
Experiments in germination and growth of damaged wheat and barley, S. B. Green, B. S. 95
Bulletin No. 7, April, 1889 95
Announcement 95
Soil temperatures, E. D. Porter, Ph. D. 95
Best varieties of corn for silage, E. D. Porter, Ph. D. 95
Comparative tests of varieties 95
Southern *vs.* flint corn for silage 96
The time to cut corn for silage 97
General conclusions 97
Improving corn by cross-fertilization and selection, W. M. Hays, B. S. A. 97
Washing and salting butter, W. M. Hays, B. S. A., and D. N. Harper, Ph. D. 98
Greenhouse walls—relative protective values of different methods of construction, S. B. Green, B. S. 98
Experiments with potatoes, S. B. Green, B. S. 99
The chemistry of wheat, D. N. Harper, Ph. D. 99
Frosted and rusted wheat 100
Modern feeding of pigs—its influence upon the formation of the skull and dentition, Olaf Schwartzkopff, V. D. S. 100

MISSISSIPPI:

Mississippi Agricultural Experiment Station 101
Bulletin No. 6, June 25, 1889 101
Charbon, S. M. Tracy, M. S. 101
Bulletin No. 7, June 20, 1889 101
Hay presses, S. M. Tracy, M. S. 101

MISSOURI:

Missouri Agricultural Experiment Station 101
Bulletin No. 5, February, 1889 101
Soil, weather, field trials with corn, P. Schweitzer, Ph. D. 101
Bulletin No. 6 102
Experiments on seed germination, pea weevil, and apples, J. W. Clark, B. S. 102
Report of committee on Missouri Agricultural College collection of apples 102
Abstracts of publications of the United States Department of Agriculture, issued in 1889 103
Bureau of Animal Industry 103

Page.

Abstracts of publications issued, etc.—Continued.

Bureau of Animal Industry—Continued.

Hog cholera, D. E. Salmon ---- 103

Report on epizootic diseases among swine, by the United States Board of Inquiry ---- 107

Division of Economic Ornithology and Mammalogy ---- 108

Bulletin No. 1 ---- 108

The English sparrow in North America, C. H. Merriam and W. B. Barrows ---- 108

North American Fauna, Nos. 1 and 2 ---- 109

Division of Forestry ---- 109

Bulletin No. 3, February, 1889 ---- 109

The use of metal track on railways as a substitute for wooden ties, E. E. R. Tratman, C. E., and B. E. Fernow ---- 109

Report on experiment in wood seasoning, G. H. Ellis ---- 110

Relation of railways to the timber resources of the United States, E. E. R. Tratman, C. E ---- 110

List of publications of the U. S. Department of Agriculture, August 15 to November 15, 1889 ---- 111

List of station bulletins, August 15 to November 15, 1889 ---- 113

EXPERIMENT STATION RECORD.

Vol. 1. **NOVEMBER, 1889.** **No. 2.**

EDITORIAL NOTES.

The Association of American Agricultural Colleges and Experiment Stations held its third annual convention November 12–15 at Washington, in the lecture room of the National Museum.

Seventy-two delegates from fifty-two institutions in thirty-three States were present at the opening session, and this number was afterwards increased to about one hundred. The Territory of New Mexico was represented by President Hadley, of Las Cruces. The community of interests between the United States and our northern neighbors was indicated by the presence of Professor Saunders, of Toronto, Canada. President Atherton, of the Pennsylvania State College, presided with the great skill which he has displayed in two previous conventions. Since a full report of the proceedings will be published as a separate bulletin of this Office, only a few of the more prominent features of the meeting will be referred to here.

The annual address of the president dwelt strongly upon the importance of preserving and strengthening the union of the colleges and stations provided for by the act of Congress under which the stations are organized. In his judgment the colleges gain in intellectual power and in public favor by having original researches in agriculture made under their auspices, the results of which are widely published among the farmers. The stations, on the other hand, are enabled to do more thorough work by availing themselves of the resources of the colleges, and by having the stimulating influences of those educational and scientific impulses which emanate from institutions of learning.

Among the discussions which elicited especial interest was that relating to the cooperation of the stations and the Department of Agriculture in the testing of varieties of flax, hemp, jute, and ramee, and of fiber machinery. At present the United States annually import about $40,000,000 worth of these textile fibers and their products, one-half of which at least, it is believed, might be profitably raised and manufactured at home. The Department proposes to procure seeds of these fibrous plants and distribute them to the stations willing to test them, and to receive from the stations the samples of the plants raised, to be used in tests of machinery at the Department.

A paper read by Dr. Jenkins, of Connecticut, on uniformity in the methods and records of work in chemical laboratories was followed by earnest discussion, which was renewed at various times, on the ways and means for reaching the greatest possible accuracy in the chemical work of the stations in testing fertilizers, dairy products, etc., and making its results as intelligible as practicable. Resolutions were passed to secure these desirable ends. Dr. Neale, of the Delaware Station, who has had long experience in Europe, spoke of the great respect in which the work of American official chemists is held there. In his judgment there is no better work in chemical analysis done anywhere in the world than in this country.

The relations of the colleges and stations to agricultural fairs and to farmers' institutes were carefully considered. Mr. Willits, assistant secretary of agriculture, spoke strongly in favor of sending out speakers from the colleges and stations to address farmers' meetings. It was the general sentiment of the convention that the stations should exhibit their work at State fairs, but should not contend for premiums. The farmers' institutes were heartily indorsed.

Professor Atwater, while discussing the obligations of the colleges and stations under the act of Congress, urged that the colleges should assist the stations as far as possible by placing at their disposal buildings, farms, laboratories, libraries, and other appliances, and that the stations should follow those lines of work in which they could take full advantage of the resources of the colleges. In his judgment the individual stations should confine themselves to thorough work upon a limited number of subjects, and conduct their investigations on such a scale and with such scientific accuracy as to secure results of permanent value.

Resolutions were passed asking the Department of Agriculture to begin without delay the collating and translating of the results of work done in similar lines in foreign countries. Of this material there is already a very large accumulation, and it would greatly promote the economy and effectiveness of station work in this country if foreign experience could be made readily available to our workers.

The co-operative work undertaken by the station horticulturists was presented in a report of the committee on horticulture, prepared and read by its chairman, Mr. Alwood, of Virginia. The horticulturists have begun the testing of a great variety of new fruits and vegetables, and propose to issue reports of their tests on a uniform plan, which will give the originator satisfactory testimony as to the value of his novelties, and at the same time protect the public against unscrupulous nurserymen. They are also endeavoring to systematize the naming of fruits and vegetables, with a view to doing away with the meaningless and bombastic appellations which are often given by enthusiastic tradesmen. Mr. Alwood also announced the early publication, through the Office of Experiment Stations, of a bulletin containing a list of the officers having horticultural work in charge, and an outline of this work at the several stations.

A number of distinguished gentlemen, representing various interests outside of the association, made brief addresses. Senator Reagan, of Texas, gave his experience in the cultivation of alfalfa, which he strongly recommended as a forage plant. General Morgan, Commissioner of Indian Affairs, urged the colleges to prepare teachers qualified to instruct the young Indians in agriculture and mechanic arts. Captain Pratt, president of the Indian school at Carlisle, Pa., stated that the Indian boys of his school had earned some $12,000 during the past year by manual labor on farms and elsewhere. Mr. Willis, of the Geological Survey, explained what the Survey was doing in mapping the soils of the country, preliminary to their more thorough study by agricultural investigators. Dr. Eggleston, in behalf of the American Forestry Association, urged the stations to impress upon the farmers the great desirability of tree culture.

The most important formal action taken by the association pertained to changes in its organization. Standing committees on agriculture, botany, chemistry, entomology, and horticulture were created to look after these special interests, and to assist in the preparation of programmes for meetings of the association, which should make provision for general and sectional sessions, and thus secure the discussion of a greater variety of technical as well as general topics. These committees, through their chairmen, are to present reports of progress in the several lines of station work at the next convention, and also to prepare programmes for the meetings of the several sections. It is hoped that this action will greatly increase the interest of all the workers in the colleges and stations, as well as others laboring in kindred lines, in these annual assemblies of workers in agricultural science, and at the same time promote the efficiency of the association as an aid to co-operative action among the various institutions represented in its membership.

A noteworthy feature of this meeting of the association was the general desire to discuss methods of work rather than administrative questions. The meetings of the sections in particular were largely personal conferences, devoted to business-like discussions of subjects immediately connected with the experiments and investigations in which the stations are now engaged. The spirit of harmony, the profound sense of common interests and aims, and the determination to meet the needs of practical farmers, manifested throughout the meeting, are additional evidences of the hopeful condition of the great enterprise for the promotion of agricultural science and education, to which the American people, through the repeated action of Congress, have so fully committed themselves.

The officers chosen for the ensuing year are: President J. H. Smart, of Indiana, president; Presidents M. E. Gates, of New Jersey, and G. T. Fairchild, of Kansas, and Directors F. A. Gulley, of Texas, R. J. Redding, of Georgia, and E. W. Hilgard, of California, vice-presidents; Director H. P. Armsby, of Pennsylvania, secretary and treasurer; Presidents H. E. Alvord, of Maryland, and S. D. Lee, of Mississippi, Vice-director E. H. Jenkins, of Connecticut, President W. H. Scott, of Ohio, and Director M. A. Scovel, of Kentucky, executive committee.

At one of the sessions of the association Dr. C. Hart Merriam called attention to the work of the Division of Ornithology and Mammalogy of the Department of Agriculture in determining the boundaries of what may be termed the life areas of the country, each of which is characterized by the possession of forms of life not found in adjacent areas. The various forms of wild and domesticated animals and plants having become adapted to certain definite combinations of physiographical conditions outside of which they can not thrive, the farmer might use a map of these "life areas" to aid in determining what kinds of crops and animals to raise in particular regions. The co-operation of the stations with the Division of Ornithology and Mammalogy in studies necessary to the preparation of such a map is desired.

The recently organized Association of Official Economic Entomologists held a meeting at the National Museum during the same days in which the general association was in session. New members were elected, by-laws adopted, a number of important topics discussed, and several valuable papers read. The topics under discussion were: (1) Where shall we publish descriptions of new species and results of non-economic observations? (2) How far shall we recommend patent insecticides and machinery? (3) Co-operation. (4) Amendments to the constitution.

The following papers were read: Notes on a corn-root worm in Kentucky, and the Bordeaux mixture as an insecticide, Prof. H. Garman, of Kentucky; office and laboratory organization, Prof. S. A. Forbes, of Illinois; spraying points, and experiments in destroying the codling moth, Prof. C. P. Gillette, of Iowa; on *Diabrotica longicornis*, Prof. Lawrence Bruner, of Nebraska. The discussions were of great interest, and the meeting as a whole was a very successful one.

ABSTRACTS OF BULLETINS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES FROM JANUARY TO JUNE, 1889.

PART II.

KENTUCKY.

Kentucky Agricultural Experiment Station.

Department of the Agricultural and Mechanical College of Kentucky.
Location, Lexington. Director, M. A. Scovell, M. S.

BULLETIN No. 17, FEBRUARY, 1889.

FIELD EXPERIMENTS WITH CORN, M. A. SCOVELL, M. S., AND A. M. PETER, M. S. (pp. 3–21).—This is a first report of the series of experiments begun in 1888 on the Station farm to study the effects of different fertilizing materials upon corn in the particular soil under experiment, which is in the Blue Grass region, and is derived from the lower silurian limestones. Engravings from photographs illustrate the effects of different fertilizers on corn.

Effects of leading elements of plant food in various combinations on corn.—Sulphate of potash, sulphate of ammonia, and acid phosphate were used singly and in combination. Although there was no considerable duplication of fertilized plats, the results, which are stated in tabular form, imply very strongly that for corn potash is especially needed on the soil of the Station farm. Other experiments imply that the same is true for potatoes, hemp, and tobacco; and the indications are that wheat also would be greatly benefited by the application of potash. A natural inference is that on soils of like character in the Blue Grass region generally the same fertilizer will be useful, but this can be demonstrated only by actual trials.

Financial results from the use of various fertilizers on corn.—It appears that (1) there was a profit in every instance where potash was used, potash alone yielding the largest net profit; (2) where phosphoric acid and nitrogen without potash were used none of the money paid for the fertilizer was recovered; (3) the phosphoric acid and nitrogen applied with potash probably caused little, if any, increase of yield, showing that the money paid for them was unprofitably expended.

There were last year legally on sale in this State 43 different brands of fertilizers, containing less than 2 per cent of potash; if we had applied any one of these to our soil for corn no marked increased yield would have been apparent, not because the fertilizers were worthless (as they undoubtedly would have produced good results on soils deficient in phosphoric acid and nitrogen), but because they did not contain the potash necessary for the corn crop on our soil.

Effect of barnyard manure as compared with that of the leading ingredients of commercial fertilizers in various combinations.—"Barnyard manure produced an increase in yield slightly greater than was obtained on the plats which received 100 pounds of sulphate of potash per acre."

Effects of copperas (sulphate of iron) on corn.—No noteworthy benefit was apparent.

Tobacco stems as a fertilizer for corn.—This is an important matter in Kentucky, where thousands of tons of tobacco stems are annually wasted. The experiment was vitiated by accidental circumstances.

The relation of fertilizers to shrinkage of corn in curing and to proportion of cob to kernel.—The per cent of shrinkage in weight varied from 7.4 to 18.3, being very much the greatest when barnyard manure was used. The proportion of cob to kernel varied only slightly.

Relation of amounts of phosphoric acid, nitrogen, and potash in the fertilizers to amounts of the same ingredients taken up by the crop.—Analyses of corn, including stalk, kernel, and cob, showed that in no case where potash was used was as much potash contained in the crop as was applied in the fertilizer. In some of the cases in which phosphoric acid was applied the quantity in the crop was larger than that in the fertilizer, in others not. In every case where potash was applied there was more nitrogen in the crop than was applied in the fertilizer.

BULLETIN No. 18, APRIL, 1889.

HEMP EXPERIMENTS (pp. 3–8).—This is a preliminary study of the question as to the practicability of the successful growth of hemp on old ground by means of commercial fertilizers. Experience in Kentucky is unfavorable to the growing of hemp on worn-out land, or even on land which is comparatively rich but has been in cultivation with other crops. A rank growth of hemp may be obtained on old land by applying fresh barnyard manure, but the quality of the product is generally inferior.

The fertilizers, which supplied nitrogen, phosphoric acid, and potash in different combinations, were similar to those used in the corn experiments reported above. The apparent benefit from phosphoric acid and nitrogen was very small. As in the case of corn, the fertilizing ingredient most needed was evidently potash. The yield of hemp was unsatisfactory both in quantity and quality. This was apparently due, to a great extent, to the unfavorable season. Engravings from photographs illustrate very clearly the effects of the different fertilizers on the hemp.

Notes on the treatment of an old apple orchard (pp. 9–13).—This article contains a statement of facts showing the decided benefit of spraying the apple trees with London purple, to prevent the ravages of the codling moth, which has "nearly destroyed successful apple culture in this locality."

BULLETIN No. 19, MAY, 1889.

Experiments in pig-feeding, J. H. Connell, B. S. (pp. 3–19).—These were preliminary experiments to test the relative values of shelled corn, corn meal, cob meal, wheat bran and ship stuff for keeping and for fattening, and the various lengths of time that the feeding may be continued with profit. Six Chester Whites, five "Thin Rinds," and one Red Berkshire, all mixed breeds, were used. The details of these experiments will be included in a special bulletin on pig-feeding to be issued by this Office. The results imply that fat is more rapidly produced by shelled corn, and more cheaply by corn than by the other foods tested; that much corn-cob meal was wasted in the feeding; that cotton-seed meal was unprofitable; that the nitrogenous foods produced comparatively little gain in live weight, but that the pigs fed on them were so much stronger than the others that they caused the latter serious injury when they were turned out together; and that in the tests of nitrogenous foods a mixture of corn-cob meal and ship stuff in equal parts was the cheapest. The experience with cotton-seed meal was unsatisfactory.

LOUISIANA.

No. 1. Sugar Experiment Station, Audubon Park, New Orleans.
No. 2. State Experiment Station, Baton Rouge.
No. 3. North Louisiana Experiment Station, Calhoun.

Department of Louisiana State University and Agricultural and Mechanical College. Director, William C. Stubbs, Ph. D.

BULLETIN No. 20 (SUGAR STATION), JANUARY, 1889.

Field experiments on sugar-cane (pp. 199–252).—This Station is engaged in studies regarding the soil, fertilizers and methods of culture for sugar-cane, and the manufacture of sugar. When the experiments recorded in this bulletin were made the Station was located at Kenner. The bulletin is devoted to a record of field experiments, mainly a continuation of those of previous years, on germination and growth from "plant cane" and from stubble under different conditions; physiological questions, including influence of suckering on cane; varieties best adapted to Louisiana; and manurial requirements.

Germination questions (pp. 199–208).—While in some sugar-producing regions, as Cuba, the sugar-cane is generally grown through a long series of years, each season from the stubble of the previous season, in Louisiana frequent replanting is found necessary. For this the cane itself is used. The quantity required is very large, and makes an important factor of the cost of sugar production. The lower part of the stalk is richest in available sugar. If the upper part of the stalk could be conveniently and successfully used for planting, great saving might result. In the series of experiments begun in 1886–87, and continued in 1888, the "part of the stalk best for seed" and "growth from stubble" have been tested.

Stalks of cane kept for planting (pp. 199–203).—"The stalks were cut up into short pieces, beginning with the green, immature top and ending with the butts. Two eyes were left upon each cutting, and each stalk was selected so as to give eleven cuttings. Seventy-five of these cuttings, containing 150 eyes, were devoted to each experiment." There were thus eleven experiments, one for each of the parts into which the stalks were cut. Observations for each experiment included the number of stalks from the 150 eyes planted; development at different dates during growth; yield of stalks; results of chemical analyses, including degree Baumé, total solids, sucrose, glucose, co-efficient of purity and glucose ratio of juice; and total calculated yield per acre of stalks and of available sugar, etc.

The results obtained in 1887 from the quantity planted that year are given, and followed by results obtained in 1888 from the stubble of the cane of the previous year.

Among the conclusions are, that in 1887 "the upper joints germinated more rapidly than the lower ones, and that many sprouts from the green, immature tops died during drought, but that the upper, mature joints were fully equal, if not superior, to the lower joints for seed."

> In 1888, barring the whole joints, the upper part of the cane gave slightly better results in stand, in tonnage, and in sugar, confirming the results of the previous years. It is therefore again asserted that could a practical way be established for utilizing as seed the upper thirds of all the cane and grinding the remainder, an immense gain would yearly accrue to our industry.

Number of stalks of cane to plant—Plant vs. stubble cane for seed (pp. 203–208).—In 1887 different plats were planted with cane in different degrees of thickness (from one cane with a lap to four canes with a lap) in rows 7 feet apart. The whole cane, upper and lower halves, and upper, middle, and lower thirds were used in different rows. On one plat unslaked lime was applied. In 1888 one-half of the field was newly planted, but the other half was allowed to grow from the stubble of 1887. Observations on germination and on development, produce of stalks, chemical composition of cane, and yield of sugar were made as in the experiments described above. "These experiments strongly point to the conclusion that with good cane in well-prepared soil, and with good seasons, two canes and a lap furnish an abundance of seed and the largest profits."

The sugar content and stubble from "stubble seed" were slightly superior to those of "plant seed."

Suckering (p. 208).—Experiments in 1886, 1887, and 1888, in which suckers were cut and allowed to grow, brought results decidedly in favor of the suckers. They show that "suckering or tillering is a necessary and healthful condition of the sugar-cane," and that "stubble comes both from the original sprouts and from suckers."

Distance between cane rows (pp. 208–215).—Experiments were made in 1888 with rows from 3 to 8 feet apart, "seeded" with plant cane and stubble, and treated with commercial fertilizers. The amounts of cane per acre required for planting at the different distances, yield of cane, composition, and available sugar per acre are given. The results were favorable to a distance between the rows much less than the common distance of 7 feet. Experiments in this line will be continued.

Varieties of cane (p. 215).—More than seventy varieties of cane from all parts of the world have been received through the United States Departments of State and Agriculture. A report on forty-eight of these varieties grown at the Station will be issued in a separate bulletin.

Effects of fertilizers on sugar-cane (pp. 215–252).—"One of the chief aims of this Station is to find a fertilizer that will produce a maximum tonnage with a maximum sugar content upon the soils of Louisiana." To this end experiments, classified as scientific and popular, were made on 7 plats. On the 5 "scientific plats" the experiments were (1) with nitrogen, (2) with phosphoric acid, and (3) with potash. The objects were to test (1) the requirements of the soil used for each ingredient, (2) the forms of fertilizers best adapted to cane, and (3) the quantity most profitable for cane. Potash, phosphoric acid and nitrogen were applied in different amounts and forms of combination, each with an excess of the other ingredients, in order to make a fair test of the requirements of the soil for the ingredient in question and the specific effect of the latter upon the cane. In the "special nitrogen experiments," for instance, a basal mixture containing phosphoric acid and potash is used, and to this nitrogen is added in different amounts and different forms of combination. The mixtures containing the different quantities of each form of nitrogen taken together are called a group. There are thus in each special nitrogen experiment as many groups as there are forms of nitrogen tested. The advantages of the duplication of tests with each ingredient are well brought out by the details of the report, which are given in tables with summaries in the text. They include total yield, composition as shown by analysis, and amounts of available sugar.*

Potassic fertilizers—Special potash experiments (pp. 216–221).—In this experiment the object was to test first and primarily the requirements of the soil used for potash, and secondly the form and quantity of potash best adapted to cane. Potash was used in the form of muriate, sulphate, nitrate, carbonate, and kainit, in quantities representing 60, 120, and 180 pounds of actual potash per acre, or one-third, two-thirds, and full rations for the three quantities. For each form of potash there was a group of 3 plats for the three quantities, making, with the matured plats, which had no potash, and the unmanured, 25 plats. The experiments were made on second-year stubble cane. Results are given in tabular form. The carbonate of potash and ashes of cotton-seed hulls did not bring the results expected. With potash in the other forms the increase in yield was considerable.

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* The general plan of these experiments corresponds with those made by a number of experimenters and described in pages 24–28 of Circular No. 7 of the Office of Experiment Stations, on "Co-operative Experiments with Fertilizers," and in more detail in bulletins published by the U. S. Department of Agriculture in 1882 and 1883 as "Co-operative Experimenting as a Means of Showing the Effects of Fertilizers and the Feeding Capacities of Plants," and as "Results of Field Experiments with Fertilizers," by W. O. Atwater.

Phosphoric acid fertilizers—Special phosphoric acid experiment (pp. 222, 223).—The object of this experiment was to test the form and quantity of phosphoric acid best adapted to cane. The phosphoric acid was used in the soluble form in dissolved bone-black and acid phosphate; in the "precipitated" form in "precipitated bone-black" and acid phosphate; and in the soluble form in bone-dust, in the finely ground Charleston phosphate called "floats" and in Orchilla guano. Each was used in a group with three quantities, one-third, two-thirds, and full ration. The general plan was similar to that of the experiments with potash above described. A part of the experiment was injured by defective stand, and the results were everywhere so irregular that definite conclusions could not be drawn.

Experiments with common commercial fertilizers (pp. 224–228).—The object here was to test the value of certain popular fertilizers, and also the quantity most desirable. The trials were made on second-year stubble. Cotton-seed meal and tankage were used alone and in combination with acid phosphate, "floats," kainit, ashes, cotton hulls, etc., on 35 plats. The results are stated in tabular form. Taking the produce as the measure of the action of the fertilizer in each case, sulphate of ammonia and dried blood were about equally valuable as sources of nitrogen. Inspection of the table shows also that "large tonnage is not always productive of largest sugar yields, and, therefore, manuring should be done judiciously both as to quantity and quality."

Tiled vs. untiled land (pp. 228–233).—To test the effect of tile drainage, two plats, one tiled and the other untiled, were planted with cane in 1887. They were each subdivided into 19 plats, of which 6 were unmanured and the rest treated with fertilizers of various kinds, including cotton-seed meal, acid phosphate, kainit, bone-dust, Orchilla phosphate, and cotton-seed-hull ashes, singly and in combination, thus making two sets of experiments, alike as to manuring and cultivation, but differing in that in one the land was drained and in the other undrained. The details as to produce, chemical composition, and yield of sugar are given as in previous experiments. The average increase of yield of all the tiled plats over the untiled was at the rate of 4.37 tons per acre. The general results for the two years, 1887 and 1888, strongly favor tile draining. Besides giving a better yield of cane and sugar, the tile-drained lands are warm and mellow, so that roots penetrate more easily and deeply, and are thus better able to resist drought, while in wet weather the excess of moisture is drawn off. On these lands, also, the snow melts at least a week earlier on an average, and vegetation advances far more rapidly.

"Drainage is of the first importance to the sugar planter, since cane revels in well-drained land." "Tile drainage, like 'diffusion,' is surely but slowly coming."

Effect of turning under and of removing pea-vines on first-year stubble cane (pp. 234–239).—These were experiments with and without pea-vines, to test the value of (1) the roots and stubble alone and (2) the roots and whole vines. Cow-peas were sown broadcast on the experimental field in the spring of 1886, and in September of the same year the pea-vines were removed from one-half of the field. The whole field was then plowed and used for the experiment. A portion was planted with plant-cane and the rest with stubble. The experiments were divided into five groups—two fertilized at time of planting, two in the following spring, and one not fertilized. In each group were four plats, two with peas turned under, and two with the vines removed. The fertilizers used were cotton-seed meal, acid phosphate, kainit, nitrate of soda, and sulphate of ammonia, in various combinations. The yield per acre, chemical composition, and available sugar are given in tabular form for each plat, together with the quantities of nitrogen, phosphoric acid, and potash per acre supplied, and the increase of yield on the manured plats. From the results stated it appears that potash in small quantities produced no effect upon these soils, that excess of phosphoric acid has not been especially beneficial, and that approximately equal parts of nitrogen and phosphoric acid are perhaps the best mixture for stubble-cane on these lands.

Effects of nitrogenous fertilizers on cane—Special nitrogen experiments (pp. 239–243).—These experiments were made in 1888 with spring plant cane to get light upon the question of the advantageous forms and amounts of nitrogen for cane. As former experiments had shown that the full ration of nitrogen (72 pounds per acre) was injurious, only one-third (24 pounds per acre) and two-thirds (48 pounds per acre) rations were used. The general plan of the experiment was similar to that of the special phosphoric acid and potash experiments. A basal mixture ("mixed minerals") supplied 500 pounds of acid phosphate and 80 pounds of muriate of potash. To this nitrogen was added in cotton-seed meal, fish scrap, dried blood, sulphate of ammonia, and nitrate of soda. The yield per acre, chemical composition, and available sugar are given in tabular form for each plat. As was the case in previous experiments, no one form of nitrogen was greatly superior to the others. It would seem, then, that the only practical question for the planter relates to the cost of the different forms. It may be also noted that in the previous year, during a most favorable season, 72 pounds of nitrogen per acre proved excessive, while this year, in a very wet season, 24 pounds produced almost as large a yield as 48 pounds. In other words, during the season just ended only the nitrogen contained in 350 pounds of cotton-seed meal per acre was appropriated by the cane.

Effects of various special fertilizers on cane (pp. 243–246).—This is a record of experiments with the St. Denis, Ville's, and other formulas. The amounts and relative proportions of the fertilizing ingredients did not seem to be such as were best fitted to the soil under experiment, and the cost was large.

Effects of different mixtures of cotton-seed meal and acid phosphate (pp. 246–248).—The object here was to get information as to the best mixtures of cotton-seed meal and acid phosphate for plant cane. On one plat cotton-seed meal was used alone; on the others it was combined with the acid phosphate so as to give the following ratios of nitrogen to phosphoric acid: 1:3, 1:2, 1:1, 2:1, and 3:1. Nitrogen and phosphoric acid in the ratio of 1:2 gave the largest yield.

Summary of results (pp. 249–252).—"The year just closed has served to emphasize in a most positive manner the deductions of former years. * * * The experiments here are sufficiently pronounced in their results to convince the most skeptical of the efficacy of manures on cane when they are properly compounded and intelligently applied." The results in 1888 confirm as well as add to the conclusions from those of previous years. Among the inferences drawn from them are:

1. The upper portion of cane is equal, if not superior, to the lower part for "seeding."
2. "There was but little difference in the stubble of those plats whereon different numbers of stalks were used in planting."
3. "Seed from good first-year stubble has given as good results the first and second years as seed from plant."
4. "Stubbles (rattoons) come equally well, and perhaps better, from the original sprouts than from suckers."
5. Nitrogen is greatly needed by the soils of Louisiana to grow cane. As the experience indicates that no one of the leading forms has any marked superiority, cotton-seed meal, a cheap home product, may be used instead of expensive imported articles.
6. Excessive quantities of nitrogen have this year been but partially utilized by the crop, and "are always injurious to sugar content." The experiments of the past three years strongly suggest that from 21 to 42 pounds of nitrogen per acre (the amount found in from 300 to 600 pounds of cotton-seed meal) are all that can be profitably used. To produce the best results the nitrogen should be combined with mineral manures.
7. The mineral manures alone are without decided effects, except on new grounds and pea-vine fallows, and even then the yields are often much improved by nitrogenous fertilizers.
8. The phosphoric acid needed by the soils of the State is best sup-

plied in the soluble form as acid or superphosphate, though the insoluble forms in Charleston "floats," Orchilla and Grand Cayman guanos, seem to be available after lapses of time, depending upon the character of the soil and the fineness of the fertilizer.

9. Excessive quantities of phosphoric acid are not economical, though they are not altogether lost. From 40 to 75 pounds per acre seem to be ordinarily the limits for profitable production.

10. Potash in small quantities produces no apparent effects upon either tonnage or sugar content, but in excessive quantities for several years on the same soil increases the yield but not the sugar content.

11. Pea-vines turned under have produced more effect on stubble than on plant cane.

12. The beneficial effects of tile drainage grow larger from year to year. In 1886 and 1887 the increase of yield due to drainage was about 35 per cent, and in 1888 about 50 per cent.

13. Growing cane in narrow rows in 1888 gave increase of yield and sugar content, and is worthy of further investigation.

ANALYSES OF FERTILIZERS (p. 253).—A record of the analyses of the fertilizers used in the experiments on sugar-cane above described.

METEOROLOGY (pp. 254–266).—Records for each month of 1888.

BULLETIN No. 21 (STATE STATION), JANUARY, 1889.

REPORT OF STATE EXPERIMENT STATION FOR 1888 (pp. 271–289).—This contains an account of the location, soils, improvements, live stock, garden, and orchard of the Station, and details of experiments with forage plants, grains, grasses, clovers, corn, and cotton.

Garden and orchard (p. 273).—In the garden fifty-six varieties of strawberries, raspberries, and blackberries have been planted. A large orchard, with leading varieties of some twelve or more kinds of fruits, and a vineyard with thirty varieties have been planted.

Forage plants (pp. 273–277).—Varieties of sorghum, field peas, and other forage crops grown are mentioned, with notes on peas. The results of inconclusive experiments with fertilizers on sugar-cane are given in tabular form.

Small grains, grasses, and clovers (pp. 277, 278).—Experiments are being made with varieties of wheat, oats, barley, clovers, and grasses. Texas blue-grass (*Poa arachnifera*), introduced from Alabama, made a vigorous growth at the Station in 1888, and promised well for winter pasture. Pará grass (*Panicum barbinode*) from Florida has been introduced.

Experiments with corn (pp. 278–283).—These were made to get light upon the questions as to what varieties are best adapted to the soil and climate of Louisiana, and what kinds and quantities of fertilizers are needed for corn on the soil used in the experiments. All the experiments were injured by cut and bud worms, and the reliability of the estimated results impaired.

Test of eighteen varieties.—The calculated yield per acre, percentages of corn and shelled corn, etc., are stated in tabular form.

Fertilizers for corn.—To test the needs of the soil and the effects of the important fertilizing ingredients in different forms and amounts, special phosphoric acid, potash, and nitrogen experiments were made on the plan of those with sugar-cane described in Bulletin No. 20 of the Sugar Experiment Station, and summarized above. The results in 1888, were inconclusive, but the experiments will be continued.

Experiments with cotton (pp. 283–289).—The purpose of these was to test varieties of cotton, considering yield of cotton seed and percentage of lint and the manurial requirements of cotton on the soil of the experiments. The plans were similar to those of the experiments with corn just described. Thirty-eight varieties were planted and were growing finely, when they were destroyed by a storm August 19. Some results are given, however, both for the tests of varieties and for those with fertilizers. The indications are that nitrogen is especially needed on this soil for cotton, but further experiments must be undertaken before definite conclusions can be reached.

Experiment in rotation of crops.—Eight acres of land have been accurately laid out for an experiment with cotton, corn, oats, and peas, in rotation. Two acres are devoted to each crop, one acre being fertilized yearly, the other unmanured.

Formulas for fertilizers for corn and cotton.—This Station sees no reason for changing the formulas for corn and cotton published heretofore in its bulletins, and in reply to the numerous inquiries from planters and farmers will here repeat those for cotton, found heretofore so efficacious:

	Pounds.
Cotton-seed meal	700
Acid phosphate	1, 100
Kainit	200

Mix thoroughly and apply in a shovel furrow before planting, taking care to mix well with soil by running a bull-tongue through it after distribution. From 200 to 500 pounds per acre are quantities usually recommended. If cotton seed is on hand, it may be profitably made into a compost with stable or lot manure and acid phosphate in following proportions:

Cotton seed	bushels	100
Manure	do	100
Acid phosphate	ton	1

For sandy land 1,000 pounds of kainit may be advantageously added. Mix well this compost before use and apply from 300 to 1,000 pounds per acre in drill before planting.

BULLETIN No. 22 (NORTH LOUISIANA STATION), JANUARY, 1889.

ANNUAL REPORT OF THE NORTH LOUISIANA EXPERIMENT STATION (pp. 293–320).—This Station, established among the hills of North Louisiana and intended primarily to benefit that section, receives enthusiastic support from the farmers. One evidence of this is the large attendance at the monthly meetings of a farmers' club held at the Station, which has undertaken to build a large hall on the Station grounds. The local railroad has helped this movement by running excursion trains on the days of the meetings of the club. The Station farm comprises 330 acres in Ouachita parish near the village of Calhoun. This came into the hands of the State University and Agricultural and Mechanical College April 6, 1888. In spite of the lateness of the season and the poor condition of the land very much was accomplished through the skill and energy of the manager, Mr. L. M. Calhoun. Fifty acres of old fields were brought under cultivation. More than 50 acres of woodland were cleared and much rough and uneven land was made smooth. Fences were built, and contracts made for the necessary buildings. The Station is now equipped with dwellings, stables, and laboratory. Thirty acres have been devoted to experiments with cotton, corn, grasses, and other crops, in which especial attention will be given to manurial requirements. The orchard, vineyard, and garden cover 10 acres; 50 acres are devoted to general field crops, and the rest to pasture. The Station has obtained Holstein and Jersey cattle, and will soon have improved breeds of hogs and sheep. Experiments with horses are also contemplated. Poultry houses and yards have been erected, and a number of improved breeds have been obtained.

Orchard and vineyard (pp. 296–298).—The following numbers of varieties of fruits have been carefully planted and fertilized: figs, 10; filberts, 1; almonds, 4; quinces, 6; apricots, 15; nectarines, 8; chestnuts, 3; Japanese persimmons, 10; plums, 16; pears, 34; peaches, 32; apples, 40; grapes, 56; strawberries, 26.

Grasses and clovers (p. 298).—Experiments are in progress with six varieties of clovers, fourteen of grasses, and several of wheat, oats, barley, and rye.

The vegetable garden (p. 298).—In this garden varieties will be tested with a view to developing the truck industry.

Field experiments with cotton (pp. 299–307).—(1) *Effects of fertilizers on cotton* (pp. 299–303).—These experiments were conducted on two fields of the same size, one of "sandy land" and the other of "red land." They were similar in purpose and plan to the special nitrogen, phosphoric acid and potash experiments made at the stations at Kenner and Baton Rouge and described above. The questions propounded in each field were: (1) What valuable ingredients of fertilizers does this soil need to grow cotton? (2) In what proportions shall these be combined? To these was added another question: (3) Shall the fertilizers be distributed broadcast or in the hill? Cotton-seed meal and cotton seed were used to supply nitrogen, acid phosphate for phosphoric acid, and kainit for potash, separately and in various combinations. Results are given in tables. It appears that these particular soils need nitrogen very badly, and phosphoric acid and perhaps potash (kainit) in small quantities. The soils did not profit by large quantities of any ingredient, being in poor condition and imperfectly and hastily prepared.

These experiments also show that both cotton-seed meal and cotton seed are capable of supplying the plant abundantly with nitrogen. For soils similar to these a combination of cotton-seed meal and acid phosphate, in varying proportion from equal parts to one of the former to two of the latter, and used in quantities from 200 to 500 pounds per acre, seems to be admirably adapted.

(2) *Distance apart of rows* (pp. 303, 304).—The object here was to determine the best distance in width of rows for cotton on this particular soil. The distances varied from 2½ to 6 feet, and the results suggest from 2½ to 4 feet as the proper width on such soils as this.

(3) *Distance apart of the plants in row* (pp. 304, 305).—The object here was "to test the distance required by cotton in the drill to obtain best results." The rows were all 4 feet apart, and the distance between plants varied from 8 to 48 inches. The value of the experiment was impaired by the planting of several varieties of cotton through mistake, but it was plain that distances from 8 to 20 inches gave the best results.

(4) *Test of varieties* (pp. 305–307).—Thirty-one varieties of cotton were tested. The results given in a table show that the yield of cotton per acre varied from 1,444 to 1,838 pounds and the yield of lint (excluding Sea Island) from 420 to 586 pounds. The origin of the seed which showed the highest yield of seed cotton per acre and the next to the largest yield of lint is shrouded in mystery. In this trial and another at Baton Rouge this variety proved itself "the superior of many of the so-called pedigreed cottons upon which time and money have been prodigally expended in propagating and developing."

Field experiments with corn (pp. 307–311).—(1) *Manurial requirements.*—These were experiments with cotton seed and cotton-seed meal, acid phosphate, and kainit, singly and in different combinations, on the plan of those with cotton above described. The results were inconclusive, except as indicating that cotton seed and cotton-seed meal were excellent sources of nitrogen.

(2) *Proper distances between rows.*—In this experiment the distances varied from 4 to 7 feet. The best results were with rows 5 feet apart.

(3) *Yield with late planting and effects of pulling off leaves for fodder.*—The results were decidedly unfavorable to pulling the fodder, the loss in yield of corn being equivalent to 7 to 9 bushels per acre, or from 15 to 20 per cent of the corn grown. Other experiments have uniformly brought like results.

(4) *Test of fourteen varieties of corn.*—Tables show ratios of corn, cob, and shuck (husk) per acre.

Forage crops (pp. 312–320).—Notes on teosinte, pearl millet, Kaffir corn, millo maize, a number of varieties of sorghum successfully grown for fodder, and on Brazilian flour-corn, buckwheat, Chapman's honey plant, and several varieties of pea-nuts and cow-peas. The prospect for the successful growth of some of these plants in

Louisiana is good. This is a matter of much importance to the farmers of that region.

BULLETIN No. 23 (SUGAR STATION), 1889.

DIFFUSION OF SUGAR-CANE (pp. 325–361).—This contains a record of experiments made at Kenner, La., during the season of 1888, in application of the process of diffusion to the extraction of sugar from sugar-cane. The apparatus used was essentially that employed in the experiments at the same place with sorghum, and described in Bulletin No. 19 of the Station and Bulletin No. 20 of the Chemical Division of the United States Department of Agriculture. Full details of manufacture and different methods of clarification are given. Excellent results were obtained throughout. The maximum yield per ton was 240.1 pounds of commercial sugar, equal to 216.75 pounds of pure sucrose per ton. The economic superiority of diffusion over milling is thus demonstrated. [With the best milling applied to similar cane, the quantity of commercial sugar would be from 180 to 200 pounds. At the time of this writing (autumn, 1889) the diffusion process has been introduced in five or six of the largest plantations in the State.—EDITOR.]

MAINE.

Maine State College Agricultural Experiment Station.

Department of State College of Agriculture and the Mechanic Arts.

Location, Orono. Director, Whitman H. Jordan, M. S.

BULLETIN No. 1 (SECOND SERIES), MAY, 1889.

PARTIAL STATEMENT OF ANALYSIS OF COMMERCIAL FERTILIZERS FOR 1889. W. H. JORDAN, M. S. (pp. 1–3).—The annual analysis of three samples of each brand of fertilizer sold in the State is required by the Maine fertilizer law. As it is not practicable for the Station to do all this work and publish the results before the farmers purchase their fertilizers in the spring, a partial statement is published of analyses made to date. The trade values for 1889, compiled from data collected in Connecticut, Massachusetts, and other States, are given and analyses of twenty-seven samples of fertilizers reported.

BULLETIN No. 2 (SECOND SERIES).

THE APPLE MAGGOT (TRYPETA POMONELLA, WALSH), F. L. HARVEY, M. S. (pp. 1–5).—A short introduction by Director Jordan urges concerted and vigorous action on the part of the fruit-growers of the State in carrying out the practical directions given by Professor Harvey. The article contains a brief life history of this maggot and an account of methods and remedies for its prevention and destruction. Professor Harvey's account of this insect and the proper methods for its treatment confirms the results of investigations published by Professor Comstock in the Annual Report of the U. S.

Department of Agriculture for 1881–82 (pp. 195–198), in which the species in all its stages is described and figured. The following is a summary of practical advice given by Professor Harvey:

1. Thoroughly and promptly destroy all refuse from infested fruit, apple pomace, waste about the house, etc.
2. Promptly destroy windfall apples and infested fruit.
3. Destruction should be immediately after the 1st of August, and nothing short of deep burying, burning, or feeding to swine or cattle will be effective.
4. These precautions should be universally adopted.
5. The sale or importation of infested fruit should be prohibited.

THE POTATO ROT (PHYTOPHTHORA INFESTANS), F. L. HARVEY, M. S. (pp. 5–7).—An account of the life history of this fungus and of remedies to prevent its spread. The article is based on the assumption that this fungus lives over winter in the form of resting or winter spores (*oosporæ*), but recent investigations seem to prove that this is not the case.

MARYLAND.

Maryland Agricultural Experiment Station.

Department of Maryland Agricultural College.

Location, Agricultural College P. O. Director, Henry E. Alvord, C. E.

BULLETIN No. 4, MARCH, 1889.

EXPERIMENT ORCHARD, W. H. BISHOP, B. S. (pp. 47–51).—This tells of the land chosen for the orchard, condition of the orchard, and objects kept in view in selecting and arranging the trees, and gives a full list of the varieties of fruits planted.

The lines of work for which the orchard has been planned are as follows:

(1) A general variety test for the information of the fruit-growers of the State.

(2) A comparison of stock from Northern and Southern nurseries.

(3) A part of the orchard has been prepared for experiments with different fertilizers "to ascertain their effects upon trees and fruit."

(4) A collection of dwarf apple-trees (dwarfed by grafting on the stock of the Paradise apple) has been planted to obtain "results which will aid in the selection of varieties for further trial" and to compare the dwarfed and standard forms of the same varieties.

Summary of varieties in the orchard.

Apples	49	Dwarf apples	48
Peaches	80	Pears	16
Plums	15	Cherries	14
Apricots	8	Nectarines	8
Quinces	4	Crab-apples	4

Total number, 246.

There will be added to this orchard the present spring an extensive plantation of small fruits, selected and arranged on the same general system.

BULLETIN No. 5, JUNE, 1889.

HORTICULTURAL DEPARTMENT AND FIELD EXPERIMENTS, H. E. ALVORD, C. E. (pp. 53–69).—*Introductory notes.*—The purpose of the bulletin is stated to be "to report upon the work now progressing in the garden, orchard, and fields, and to briefly describe, in conjunction with Bulletin No. 4, what is being grown at the Station the present season." The grand total of useful plants grown this year includes 1,488 varieties, nearly all adapted to the climate of Maryland. To discover and report upon any synonyms which may have been grown under different names is one of the purposes of this season's work.

> The plantation of small fruits made last spring was upon much the same plan as the experiment orchard described in Bulletin No. 4. Some well-known varieties were selected as standards for comparison, and to these were added all the new varieties found in the market. A more complete list of new kinds has been attempted with the small fruits than in the orchard.

With vegetables—

> This season's work has been, in most cases, confined to a small number of standard kinds and a full list of the so-called novelties offered for sale this year by prominent seedsmen. No attempt has been made to obtain all the varieties that are offered, except in the case of Lima beans.

On account of the excessive rainfall, the present season has been very unfavorable for field work.

It is the purpose of the Station to make exhibits of products and material, arranged to illustrate useful points in practical farming, "at the Exposition of the State Agricultural Society at Pimlico and at the annual fairs of several of the county societies held in September and October."

Meteorological notes.—Rain-fall and number of rainy days per month for first six months of 1889.

Schedule of field experiments in progress at the Station, season of 1889.

(1) *In agricultural department.*

A. Farm crops. General variety tests and comparisons, especially of corn, oats, wheat, tobacco, and sorghum. "Corn: An experiment in growing Indian corn with a number of different fertilizers and combinations of fertilizing materials." Potatoes: A field test based on last year's experiments in cutting potatoes for planting (see Bulletin No. 2, Maryland Station). Early and late potatoes (one acre of each) have been planted "with the seed tubers in four different forms, viz: (*a*) A large whole potato; (*b*) a medium-sized whole potato; (*c*) a piece of usual cutting; (*d*) a piece bearing a single eye." Beauty of Hebron, New Queen, Empire State, and Dandy (a new Hebron seedling from Maine) were the varieties used. Tobacco: (*a*) Test of twenty-nine varieties; (*b*) fertilizer experiment with twenty-two varieties. Peas: Test of variety of cow-pea, called "Unknown," which proved promising at this Station last year. Sorghum: (*a*) Tests of numerous varieties; (*b*) fertilizer experiment with four varieties.

B. The forage garden: This has been begun with the purest seeds obtainable. Additions will be made from year to year.

C. Fertilizer tests: An extended series of experiments with various crops and soil tests are being planned.

D. Rotation and renovation: "A series of six plats of one-half acre each, of fairly uniform and well-worn land, have been set apart, and this season carry their first crops in a long-time experiment on the renovation of land by a systematic six-course rotation of crops, both with and without manure." (See Annual Report Maryland Station, 1888, p. 53.)

(2) *In horticultural department.*

A. Orchard fruits: Variety tests (see Bulletin No. 4, Maryland Station).

B. Small fruits: Comparisons and tests of new varieties.

C. Tomatoes: (*a*) Tests of sixty-two varieties; (*b*) comparison of a few varieties grown with different fertilizers; (*c*) "a duplicate fertilizer test with plants set in boxes of sterilized sand and plant food applied as on the plats."

D. Potatoes: Tests of fourteen seedling varieties from tubers grown last year at the Maryland and Vermont Stations.

E. Onions: "A test of the comparative earliness and quantity of product, from onion-sets of different sizes."

F. Seed tests: "An extended examination is in progress of the seeds sold in the State, especially for gardens and truck farms, to include purity, vitality, germination, and trueness to name."

Summary of varieties.

Orchard fruits:		Vegetables:	
Bulletin No. 4	246	Asparagus	4
		Beans, bush	35
Small fruits:		Beans, wax	23
Currants	9	Beans, Lima	12
Gooseberries	5	Beans, pole	22
Blackberries	19	Beets	19
Raspberries, black	12	Mangels	4
Raspberries, red	13	Cabbage	58
Strawberries	84	Cabbage, red	2
		Egg-plant	13
	142	Cucumbers	32
		Carrots	11
Grasses, etc.:		Celery	14
Grasses	74	Corn, sweet	64
Clovers	11	Kale	12
Forage plants	18	Melon, water	34
		Melon, musk	42
	103	Mustard	9
		Onions	20
Field crops:		Lettuce	35
Corn, dent	28	Parsley	5
Corn, flint	7	Parsnips	9
Corn, pop	10	Pumpkins	12
Oats	30	Potatoes	39
Wheat	34	Peas	64
Spring wheat	3	Peppers	11
Barley	4	Radish	30
Rye	3	Squash, winter	31
Sorghum	90	Squash, summer	9
Tobacco	29	Tomatoes	62
		Turnips	12
	238	Ruta-bagas	6
Miscellaneous	4		
			755
		Aggregate	1,488

MASSACHUSETTS.

Massachusetts State Agricultural Experiment Station.

Location, Amherst. Director, Charles A. Goessmann, Ph. D.

BULLETIN No. 32, FEBRUARY, 1889.

METEOROLOGICAL SUMMARY (p. 1).—For four months, ending January 31, 1888.

RECORD OF FEEDING EXPERIMENTS WITH TWELVE COWS, C. A. GOESSMANN, PH. D. (pp. 2–9).—This is a summary of several series of experiments, the primary object of which (see Bulletin 34, Massachusetts State Station, p. 5) "was to test the comparative merits of corn fodder, corn stover, corn silage, and root crops, in whole or in part, as substitutes for a good meadow hay as far as quantity, quality, and cost of production of milk are concerned." The experiments were begun in 1884 and have continued to the present. The essential details of the experiments are stated in tabular form under the following headings: (1) History of cows, including breed, age, number of calves; dates of calving; arrival (purchase) and departure (sale); number of days each cow was milked, *i. e.*, length of feeding period; milk yield at beginning and end, and average of whole period; live weight, etc. (2) The amounts and kinds of fodder, and of nutritive ingredients in each, consumed by each animal, with total cost of feed for period of observation. (3) Local market value per ton of each fodder material used. (4) Value of essential fertilizing constituents, nitrogen, phosphoric acid, and potash in the various articles of fodder used; the valuation is based on composition as shown by actual analyses of materials fed, and on the assumptions that of the amounts of these fertilizing constituents in the feed 20 per cent are sold with the milk and 80 per cent saved for manure, and that in the manure their value is similar to that of the same ingredients in the better sorts of commercial fertilizers. (5) Summary of the financial record of cows (expenses=sum of cost of cows and of feed; receipts=sum of proceeds from sale of milk and cows plus value of manure). Full details, including analyses of fodder materials and milk, may be found in the annual reports of the Station.

Grade Jersey, Ayrshire, Devon, Durham, and Dutch, and native cows, of moderate milking qualities, were used. They were secured for the experiments a few days after calving. As soon as the daily milk yield of a cow fell below from five to six quarts she was sold to the butcher and replaced by another cow. The feeding period, *i. e.*, duration of the experiment with each cow, varied from 261 to 599 days. Meadow hay (ordinary grasses), dry fodder corn, corn stover, corn silage, roots, and several green crops, such as oats, barley, vetch, serradella, and cowpeas were the principal fodders employed. Corn meal or corn-and-cob meal and wheat bran, supplemented in the majority of cases by gluten meal, formed a part of the daily feed.

The daily ration per head consisted of 18 to 20 pounds of dry fodder or its equivalent and 6½ to 9¾ pounds of grain feed.

Summary of financial record.—The following tabular summary is condensed from the details given in several tables in the bulletin. "The estimated value of the manure" is obtained by deducting 20 per cent of the valuable fertilizing ingredients of the feed, which are assumed to be sold with the milk, and reckoning the rest at 16½ cents per pound for nitrogen, 6 cents for phosphoric acid, and 4¼ cents for potash, these being current valuations for the same ingredients in commercial fertilizers.

Recapitulation of financial record of cows, extremes and average.

	Most profitable cow.	Least profitable cow.	Average of twelve cows.
Period during which cows were milked (days)	584	331	402
Average yield of milk per day (quarts)	11.6	7.7	11.1
Total cost of feed consumed	$135.05	$80.08	$87.29
Estimated value of manure produced from feed consumed	56.93	30.28	35.30
Difference (net cost of feed consumed)	78.12	49.80	51.99
Receipts from milk sold at 3 cents per quart	203.37	75.83	135.91
Estimated value of manure produced from feed	56.93	30.28	35.30
Total value received from feed consumed	260.30	106.11	171.21
Cash paid for cow at beginning of milking period	60.00	55.00	62.29
Cash received for cow at end of milking period	28.00	25.00	28.80
Difference (actual cost of cow)	32.00	30.00	33.49
Actual cost of cow	32.00	30.00	33.49
Total cost of feed consumed	135.05	80.08	87.29
Total cash outlay	167.05	110.08	120.78
Total value (milk and manure) received for feed consumed	260.30	106.11	171.21
Total cash outlay	167.05	110.08	120.78
Difference (total return for feed consumed)	93.25	−3.97	50.43
Total return for feed consumed	93.25	−3.97	50.43
Estimated value of manure produced from feed	56.93	30.28	35.30
Difference (return in excess of estimated value of manure)	36.32	34.25	15.13

The "return for feed" represents what the feeder receives for labor, housing, interest on capital invested, risk of life of animal, etc. The estimated value of the manure makes up a large part of the "total value received" and hence the larger part of the return. Thus, in the average for the twelve cows, the total return was $50.43 and the estimated value of the manure was $35.30, making the return above the estimated value of the manure only $15.13.

Among the noticeable results of the experiments are the wide variations in the profits obtained from the individual cows and the fact that this profit did not depend on either the breed or the length of the feeding period. The total return for the feed consumed ranged from $93.25 gain to $3.97 loss. The return above value of manure in like manner ranged from $36.32 gain to $34.25 loss. The most profitable cow and the least profitable but one were both of the same breed. Of the two most profitable cows one was fed for 584 and the other for only 278 days.

To the practical dairyman these experiments, conducted with the resources and accuracy of an experiment station, teach clearly the difference between cows which are profitable and those which are not, and the importance of selecting the former for his dairy and getting rid of the latter. To the experimenter and to the breeder they illustrate the futility of judging of the relative merits of different breeds from experiments with a small number of animals, though the results are less emphatic in this regard than if they had been obtained with full-blooded cows instead of grades.

Conclusions.—The following are among the conclusions drawn from these experiments:

(1) The total profit over net cost of feed and of cow in no instance exceeds 15.97 cents per day; the average in 11 cases is 12.91 cents. In one case, where the average daily yield of milk was as low as 7.7 quarts, there is a loss of 1.2 cents per day.

(2) The profit is controlled in every case by the value of manure obtainable. In one case it prevents serious loss; in one it represents the entire gain; in all others, more than one-half the gain.

(3) In selecting a diet for dairy cows, it should be remembered that the value of the manure is largely determined by the amount of fertilizing constituents in the feed.

(4) Pains should be taken to collect and preserve in its most valuable form the manure obtained from dairy cows.

(5) Although the dairy cow, aside from the value of her milk, is an important factor in mixed farming for the economical disposition of home-raised crops and the production of manure, yet her value as a mere producer of manure for the market may be well questioned.

(6) Judging from the conditions in this locality, a cow which yields on the average not more than 8 quarts a day had better be sold to the butcher than kept for milking, if the milk is to be sold at wholesale rates.

ANALYSES OF FODDER MATERIALS, C. A. GOESSMANN, PH. D. (pp. 10–12).—These include two samples of white soja bean (seed), and one of soja bean (entire plant, dry). This plant, which is valuable as food for man and domestic animals, may be successfully cultivated in a light, well-fertilized soil and in a climate similar to that suitable for Indian corn.

BULLETIN No. 33, MARCH, 1889.

ON COMMERCIAL FERTILIZERS, C. A. GOESSMANN, PH. D. (pp. 1–12).—Under a new State law discrimination must hereafter be made "between analyses of samples collected by a duly qualified delegate of the Experiment Station, in conformity with the rules prescribed by the new laws and those analyses which are made of samples sent to the Station for that purpose by outside parties. In regard to the former alone can the director assume the responsibility of a carefully prepared sample and of the identity of the article in question."

The official report of the analyses of compound fertilizers and of fertilizing materials sold in this State under certificates of compliance with the law is restricted by the new law to a statement of chemical composition and to such additional information as relates thereto. Accordingly the estimated commercial values per ton formerly given are omitted.

"This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a consideration of the particular composition of the different brands of fertilizers offered for their patronage," and thus make the kinds and amounts of actual fertilizing ingredients rather than an arbitrary money valuation the basis for comparison. Explanations are given which may aid the farmer in determining the commercial as distinguished from the agricultural value of fertilizing ingredients in the wares offered for sale. There is also a table of the "trade values of fertilizing ingredients in raw materials and chemicals, 1889."

Analyses (pp. 5–12).—These include, with others, wood ashes, "mud crab," Mona Island guano, cranberry vines, oak leaves, coal dust, chaff from grain elevator, linseed refuse, wool waste, peat and soil, peat, turf, and salt hay.

Instructions to manufacturers, importers, agents, and sellers of commercial fertilizers or materials used for manurial purposes in Massachusetts (p. 12).—This relates chiefly to the steps necessary for securing a certificate of compliance with the new law for fertilizer control in this State.

CIRCULARS, APRIL AND MAY, 1889.

ANALYSES OF COMMERCIAL FERTILIZERS, C. A. GOESSMANN, PH. D.—These include bone, tankage, cotton-seed meal, linseed meal, cotton-hull ashes, and a variety of compound fertilizers.

BULLETIN No. 34, JUNE, 1889.

METEOROLOGICAL SUMMARY (p. 1).—For the four months ending May 31, 1889.

OUTLINE OF THE WORK OF THE PRESENT SEASON, C. A. GOESSMANN, PH. D. (pp. 1–3).—The chief features of the field work are experiments with a variety of farm crops, particularly fodder crops, and experiments with reference to the effect of special ingredients of plant food on Indian corn, grasses, and leguminous plants grown on manured and unmanured lands, including Bokhara clover (*Melilotus alba*), sainfoin (*Onobrychis sativa*), and Kentucky blue grass (*Poa pratensis*); potatoes, including investigation of the cause of scab; sugar beets and sorghum; barley and oats, and a variety of foreign fodder plants. The effects of green manuring and of sowing grain broadcast and in drills are being observed. The work of the season also includes feeding experiments with various kinds of live stock, and laboratory work in chemistry, botany, and physiology.

DEPARTMENT OF VEGETABLE PHYSIOLOGY, J. E. HUMPHREY, S. B. (pp. 3–5).—"During the present season a leading subject of inquiry is the scab of potatoes." The article contains a list of questions concerning potato scab, to which readers of the bulletin are asked to send answers.

CREAMERY RECORD DURING 1887 AND 1888, C. A. GOESSMANN, PH. D. (pp. 5–13).—This is the creamery record for the experiments in these two years with milch cows reported in Bulletin No. 32. The details are embodied in tables, under the following headings: (1) Statement of articles of fodder used; (2) Record of average quality of milk and of fodder rations; (3) Value of cream produced, at creamery basis of valuation; (4) Cost of skim milk at the selling price of three cents per quart of whole milk; (5) Fertilizing constituents of cream; (6) Some conclusions suggested by the records.

The conclusions drawn include the following:

(1) The amount of fat in the milk of the different cows during 1887 varied from 3.45 to 4.50, and averaged 4 per cent; during 1888 it ranged from 3.14 to 4.86, and averaged 3.97 per cent.

(2) The quantity of milk, in quarts, required to produce one space of cream during 1887 varied from 2.42 to 1.63, and averaged 1.93 quarts; during 1888, it varied from 1.93 to 1.43, and averaged 1.72 quarts.

(3) The amount received for one space of cream during 1887 varied from 3 to 3.88 cents, averaging 3.58 cents; during 1888 it varied from 3.25 to 4 cents, averaging 3.72 cents. This is equivalent to 12.17 cents per quart of cream for 1887 and 12.65 cents for 1888.

(4) The total cost of feed for the production of one quart of cream amounted for 1887 to 15.09 cents, and for 1888 to 13.55 cents.

(5) The value of the fertilizing constituents lost to the farm by the sale of cream amounted, during both years, to from 2.8 per cent to 4.5 per cent, or on the average 3.05 per cent of the total fertilizing value of the feed. A loss of 20 per cent of the fertilizing constituents of the feed was allowed when selling the whole milk.

(6) The net cost of feed (original cost of the feed less the value of fertilizing constituents obtainable in the manure) consumed per quart of cream (1 quart=3.4 spaces) averaged for 1887, 8 cents, and for 1888, 6.47 cents. At 12.17 cents per quart of cream during 1887 and 12.65 cents during 1888 the profit above net cost of feed was 4.17 cents per quart in 1887 and 6.18 cents in 1888.

(7) "It required on an average during 1887 and 1888, 6.17 quarts of whole milk to produce 1 quart of cream."

(8) Counting the whole milk at 3 cents per quart, the skim-milk cost on an average during 1888, 1.32 cents per quart.

The feeding value of skim milk, containing 9.5 per cent of solids, as compared with whole milk, has been assumed to be in the ratio of 3.1 to 4. On this basis, when whole milk is worth 3 cents per quart skim milk would be worth 2.33 cents. On the basis of 4.33 cents per pound of digestible nitrogenous substances and of fat, and .9 cent for nonnitrogenous substances, the feeding value of the skim milk used in these experiments would be 1.91 cents per gallon. Creamery buttermilk, containing from 7 to 8 per cent of solids, has been purchased by the Station at 1.37 cents per gallon (see Third Annual Report Massachusetts State Station, p. 42). On this basis the skim milk produced at the Station would be worth 1.75 cents per gallon.

COMMERCIAL FERTILIZERS, C. A. GOESSMANN, PH. D. (pp. 14–16).—This includes a record of analyses and the trade values of fertilizing ingredients for 1889.

Hatch Experiment Station of the Massachusetts Agricultural College.

Department of the Massachusetts Agricultural College.

Location, Amherst. Director, Henry H. Goodell, M. A.

BULLETIN No. 3, JANUARY, 1889.

TUBERCULOSIS, C. H. FERNALD, PH. D. (pp. 3–20).—This bulletin is a compilation prepared "at the request of the director in response to the many demands from all over the State for information on the subject."

The subject is treated under the following captions: (1) Animals attacked by tuberculosis. (2) History of tuberculosis. (3) Distribution of tuberculosis. (4) Is human tuberculosis contagious? (5) Is bovine tuberculosis contagious? (6) Is human tuberculosis communicable to lower animals? (7) Is bovine tuberculosis communicable to man? (8) Are human and bovine tuberculosis identical? (9) Is bovine tuberculosis hereditary? (10) What are the symptoms of bovine tuberculosis? (11) Is bovine tuberculosis curable? (12) What measures should be taken to avoid the contagion?

BULLETIN No. 4, APRIL, 1889.

DIVISION OF HORTICULTURE, S. T. MAYNARD, B. S. (pp. 3–22).

Experiments in heating greenhouses; steam vs. hot water (pp. 3–7).—In order to test the comparative economy of heating with steam and with hot water "two houses were constructed, 75 by 18 feet, as nearly alike as possible in every particular. Two boilers of the same pattern and make were put in, one fitted for steam and one for hot water. Records of the temperature of each house were made at 7.30 and 9 a. m. and 3, 6, and 9 p. m." during January and February, together with the amount of coal consumed. The results of the experiments, given in tables, show that nearly 20 per cent less coal was consumed with hot water than with steam, while the temperature averaged 1.7 degrees higher and was more even. Definite conclusions can only be drawn after the further tests which the Station hopes to make.

Greenhouse walls (pp. 7–9).—The comparative value of different building materials as a protection against the weather was tested by building in a greenhouse four sections, 6 feet long by 4 feet high, as follows:

Section 1. Concrete (Rosendale cement, one part to three parts of sand).

Section 2. Hollow brick, 9 inches thick.

Section 3. Framed hollow wall covered with lining boards, building paper and sheathing on the outside, and the same without the paper on the inside.

Section 4. Same as section 3, but the space was filled with dry pine shavings.

In each of these walls was made a space 5 inches wide and 1 foot long running to the center, in which were placed thermometers so protected as not to be affected by the inside temperature of the house. Other thermometers were placed on the inside surface of the walls similarly protected from inside temperatures.

The inside and surface temperatures of each kind of walls from January 9 to March 1 are recorded in tables. The conclusions are: (1) On the inside of the wall the lined board walls filled with shavings gave the best result, that with the hollow space being but little less valuable. (2) Hollow brick and concrete walls afforded about equal protection from the cold, but were not equal for this purpose to the frame and board walls. The difference in the cost of construction of the four kinds of walls is slight, but their comparative durability can be determined only after ten or fifteen years' service.

Glazing experiment (pp. 9, 10).—Zinc strips were used between the joints in glazing a greenhouse with decidedly favorable results.

Evaporated sulphur as a remedy for mildews and insects in greenhouses (pp. 10–15).—From experiments at the Station and reports from those who have used this remedy, evaporated sulphur is recommended for the destruction of rose-leaf blight (*Actinonema rosea*), rose mildew (*Erysiphe* [*Sphærotheca*] *pannosa*), grape mildew, chrysanthemum leaf blight, and the red spider (*Tetranychus telarius*). Care must be taken to prevent the sulphur from taking fire. It may be used also as an aid in preventing mildew on lettuce (*Peronospora gangliformis*), though in growing this plant under glass the main dependence must be upon securing the proper conditions of temperature, moisture, and plant food.

Growing lettuce under glass—Lettuce mildew (pp. 11–14).—The experience of the past ten years in growing lettuce in greenhouses leads the writer of this article to the opinion that in order to escape the mildew lettuce must be grown at a low temperature, ranging from 35° to 40° at night and 50° to 70° during the day, with care to avoid sudden extreme changes of temperature; that an abundance of plant food and water must be used; that the "drainage should be good and the watering done in the morning and on bright days only;" and that nitrates of soda and potash are valuable in developing the vigorous growth of leaves.

The plum wart (*Sphæria morbosa*) (pp. 15, 16).—Experiments on the black wart or black knot of the plum were made with linseed oil, turpentine, and kerosene applied with a small brush as soon as the cases injury was done to the trees by the excessive use of turpentine and kerosene. The trees should be examined at least three times during the summer, and in each case enough of the liquid should be applied to saturate the warts. To prevent the spread of the warts by wild chokecherries, these trees should be destroyed, and the garden cherry trees should receive the same treatment as the plum trees.

Testing new varieties (pp. 16, 17).—Nine varieties of potatoes and five of beans were tested, but weather and other conditions interfered with the success of the experiment.

List of fruits (pp. 18–22).—The varieties of fruits now growing for experimental purposes at the Station include 48 of apples, 9 of Russian apples, 4 of crab-apples, 51 of pears, 33 of plums, 11 of cherries, 28 of peaches, 8 of apricots, 79 of grapes, 32 of raspberries, 14 of blackberries, 10 of gooseberries, 9 of currants, and 67 of strawberries.

MICHIGAN.

Experiment Station of Michigan Agricultural College.

Department of Michigan Agricultural College.

Location, Agricultural College. Director,* Oscar Clute, M. S.

[The bulletins of the College and the Station are published in a single series, numbered consecutively. As a rule, only a brief catalogue of the subjects of the College bulletins will be inserted in this publication.]

BULLETIN No. 43 (COLLEGE), JANUARY, 1889.

Weather Service Department: Annual Report of the Director for 1888 and the rain-fall charts of Michigan, N. B. Conger (pp. 3–33).

BULLETIN No. 44 (STATION), JANUARY, 1889.

[Bulletins Nos. 24 and 30, which treat of the same subject as No. 44, are reprinted as an appendix to this Bulletin.]

Feeding steers of different breeds, S. Johnson, M. S. (pp. 3–29).—These bulletins record an experiment on feeding representatives of some of the best-known breeds of cattle from calfhood to maturity under the same conditions. As the attempt to secure the necessary animals from breeders' associations was unsuccessful, a portion of the appropriation made by the State legislature for feeding experiments was used for their purchase. In conducting the experiment an effort was made "to get good, *average animals* of the various breeds, feed and care for them well and *exactly alike* save in amount of food, and see how they would respond in growth and flesh." Ten steers were used, two each of the Shorthorn, Holstein, Jersey, and Galloway breeds, one Hereford, and one Devon. They were fed for approximately three years under nearly similar conditions. When calves, they had milk from the cow or pail, but as they grew older this was changed to a ration of grain and cut hay, with varying quantities of roots and silage.

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* Edwin Willits, M. A., was Director of this Station until April, 1889, when he was appointed Assistant Secretary of Agriculture by President Harrison.

Tables are given which record the daily ration, weight, and gain of each animal during several months of each year of the experiment: and also for each steer, during each year, the total grain, hay, roots, and silage eaten, cost of feed, weight at the end of each year, gain per day, and cost per pound of gain. The steers were kept in roomy box stalls, well supplied with bedding. During the hot weather they ran on short pasture at night, and during cooler weather in the daytime. In the fall of the third year the steers were exhibited at several agricultural fairs in different parts of the State and at the Chicago Fat Stock Show. While at the latter place one animal of each breed was slaughtered. The bulletin contains the reports of committees appointed by the State Board of Agriculture on the relative merits of the different animals before slaughtering and also on the carcasses of the different breeds. Records of each of the six slaughtered steers and of six prize steers of 1888, taken for purposes of comparison, are given in tables under the following headings: Live weight at slaughter; weight of dressed carcass after hanging thirty-six hours; per cent of pounds net as compared with gross weight; weight of hide, tallow, fat, head, tongue, liver, heart, lungs, paunch, entrails, and trimmings; age in days on November 13 (one week before slaughtering); live weight on same day, and gain per day from birth. Another table shows the weight of dressed quarters of each of the animals used in the experiment. Illustrations are given from photographs of cuts of beef from the different animals.

Conclusions.—Among the inferences drawn are the following:

(1) The judgments of the feeder, butcher, and consumer are likely to differ greatly as regards the live animal, the carcass, and the edible qualities of the meat.

(2) Estimates of the comparative value of breeds are too often based on prejudice, resulting from lack of information.

(3) Calves properly fed from the pail will grow as well as if allowed to follow the cow.

(4) "The quality of beef produced by a combined grain ration, in which wheat bran, oats, and some oil form the principal part, is preferable to that produced by an exclusively corn ration."

(5) There is no profit in raising *average* native steers which will weigh from 1,100 to 1,300 pounds at three years, though there may be in raising *thoroughbred* steers which will weigh from 500 to 800 pounds more at the same age. "The value of good blood for beef production can not be overestimated."

(6) The cost per pound of raising steers under the same conditions varies but little with different breeds.

(7) The superiority of beef breeds is largely in their early maturity, *i. e.*, in their being well ripened at two instead of three years.

(8) "Early-maturing breeds may perhaps be sold with most profit at one year if pushed at the start."

(9) Care should be taken not to keep the early-maturing breeds until they are overripe.

(10) Shrinkage in dressing is not a measure of the value of the carcass to the butcher or the consumer.

The necessity for continued repetition of tests is emphasized. The Station has begun a second experiment with steer calves, which will be slaughtered at the end of twenty-four or thirty months, on the belief that "early maturity must be a prime factor in a profitable producer." This is only one of a series of tests "which shall give us the average of results and thus ultimately lead to something like a demonstration."

BULLETIN No. 45 (COLLEGE), MARCH, 1889.

WHY NOT PLANT A GROVE? W. J. BEAL, PH. D. (pp. 3–7).—In this bulletin the attention of the people of the State is called to the need and advantage of trees, and suggestions for planting are given.

BULLETIN No. 46 (STATION), MARCH, 1889.

POTATOES, ROOTS, FERTILIZERS, AND OATS, S. JOHNSON, M. S., AND H. T. FRENCH, B. S. (pp. 3–12.)—*Potatoes* (pp. 3–8).

1. *Tests of varieties.*—The results of trials with 18 varieties grown in 1887 and 1888 are given in a table, with details as to planting, harvesting, yield per acre, and quality. Some of the standard varieties grown on the college farm for several years, *e. g.*, Chicago Market, White Star, Rural Blush, Burbank Seedling, Alexander's Prolific, and White Elephant, were very uniform in size. In these trials the last named gave the smallest per cent of small potatoes and ranked high in aggregate yield. Chicago Market and Alexander's Prolific were among the most promising of the medium early varieties, and White Star and Dakota Red were the best of the late varieties. Rural Blush yielded well, but was comparatively poor in quality. Early Ohio was the earliest to ripen.

2. *Results with different amounts of seed.*—Plantings were made with (1) one eye, (2) two eyes, (3) one half-potato, and (4) one whole potato. The results for four successive years (1885–88) are summarized in a table. They serve to confirm the opinion of the writer, that "a medium amount of seed is better than whole potatoes or single eyes." The whole potatoes gave the largest average yield, but also the largest average of small potatoes. The single eyes gave much the smallest yield and next to the largest per cent of small potatoes. The three-eye plants were second in yield and gave the smallest per cent of small potatoes. "There was a marked gradation in vigor of growth from the one-eye up to the whole potato."

3. *Effects of fertilizers.*—Unleached ashes, plaster, and salt, singly and mixed, and a "potato fertilizer" were used. From drought and other causes the results were irregular and inconclusive.

Roots (pp. 9–11).—In the experiments here reported a few new varieties were grown side by side with standard varieties of real merit.

(1) *Tests of varieties of carrots, sugar beets, mangels, and ruta-bagas—Carrots.*—White Belgian, Danvers, and Short Horn were compared with Long Orange. Danvers and Short Horn gave relatively small yields, and, though White Belgian was more productive, its quality was apparently inferior to that of Long Orange. *Sugar beets.*—Vilmorin was compared with Lane's Improved. There was not much difference in the appearance of the two, but the latter gave considerably larger yields and was more easily harvested. *Mangels.*—Kniver's New Mangel and New Red Fleshed were compared with Golden Tankard to the advantage of the last named. *Ruta-bagas.*—Skirvings, American, and Yellow Swede yield well and are good for the table or for stock. White Russian carries a mass of fine roots, which hinder in harvesting and might impair its keeping qualities.

(2) *Effects of fertilizers on mangels.*—The fertilizers were similar to those used with the potatoes, as reported above. The results were likewise inconclusive. The largest yield was with no fertilizer.

Oats and barley—Tests of varieties (pp. 11, 12).

BULLETIN No. 47 (STATION), APRIL, 1889.

SILOS AND SILAGE, S. JOHNSON, M. S. (pp. 2–45).—The following topics are treated in this bulletin:

(1) Seven years' experience with silos and silage at the college farm.
(2) Views of prominent farmers of Michigan on silage.
(3) Experiments with silage *vs.* corn harvested in the ordinary manner.
(4) Comparative test of varieties of silage corn.
(5) Forage plants, lucern, orchard grass.

The author's experience with silage, dating from 1881, when $1,000 were appropriated by the State legislature to the farm department of the agricultural college for experiments, has been more satisfactory with each succeeding year, as may be seen by reference to the reports of the last eight years. This article aims "to give such suggestions about silos and the making and feeding of silage as our experience has shown are calculated to give the best results."

Seven years' experience with silos and silage (pp. 3–13).—Among the subjects discussed are: (1) Silos, location, construction, materials, size, methods of filling, and weighing; (2) silage, suitable crops, value as a substitute for roots, and methods of feeding. A silo built of lumber and located near the feeding place and on the same level is favored. It should be too large rather than too small. A silo 22 feet deep, 10 feet wide, and 14 feet long will be sufficient for six months' feeding of ten cows, weighing 1,000 pounds each, which consume 600 pounds of silage daily (or 108,000 pounds in six months). A description of the last silo built at the college is given.

Indian corn is stated to be "the great silage crop," and the dent varieties judged to be more valuable than sweet corn. At this station the corn is sown with a corn planter, in drills 3 feet 9 inches apart, 12 quarts to the acre, and is thoroughly cultivated. May 10 to 20 is the best time to plant in Michigan. The corn should not be harvested until well matured. For the silo the stalks should be cut in half or three-quarter inch lengths, and care should be taken to have the silage evenly leveled and solidly packed. The author thinks the question of weighing the silage is simply one of economy as to the saving of silage. "It would often be as expensive to draw and cut the straw and hay (necessary for a covering) as it would be to put on a moderate weight if materials are at hand." The experience of last winter indicated that "good corn silage is more than a substitute for roots." The cattle improved rapidly in flesh and general appearance when silage was fed in place of the dry corn fodder and roots previously given them.

Views of Michigan farmers on silage (pp. 15–31).—This includes a list of questions relative to silos and silage addressed to prominent farmers, and their replies, which are for the most part decidedly in favor of the silo.

Experiment with silage vs. corn harvested in the ordinary way (pp. 31–37).—Three acres of "good silage corn" were harvested "when nicely glazed." The product of one-half of this area was weighed and put in a silo, that of the other half was shocked in the ordinary way and husked when dry; the stalks were drawn to the barn and the corn and cobs were ground. Ten cows, five in milk and five dry, were fed dried corn stalks and silage alternately during four periods of three weeks each. They thus had dried corn fodder for six weeks and silage for six weeks. Bran and clover hay were fed with both the dry fodder and the silage. The quantities of hay were the same throughout, but about 10 per cent more bran was fed with the silage than with the dried corn. The materials were not analyzed, and the data given do not show whether the amounts of silage fed in the one case and of the fodder corn with corn-and-cob meal in the other, represent the products of the same areas or contain corresponding quantities of actual nutrients. The conclusion is that although nearly a quarter of the silage had spoiled, it lasted longer than the stalks and corn-and-cob meal, and that the cows gained more weight on the silage than on the dried fodder and meal. Taking into account the cost of handling, storing, husking, grinding, etc., the silage was undoubtedly cheaper.

Corn—Test of varieties to determine their value for silage (pp. 38–42).—Twelve varieties were tested in the field. A severe drought reduced the yield. Notes on the habits of growth of each variety are given. The results are summarized in a table, in which the yields per acre are estimated from the weights of one row of each variety. The observations made do not lead to complete and definite conclusions regarding the relative merits of the several varieties.

Forage plants (pp. 42–45).—The following were grown last season: serradella. *Spergula maxima*, sheep fodder (*Vicia velosa*), yellow lupine, vetches, Brazilian flour corn. Kaffir corn. Camaroon corn. teosinte (*Euchlæna luxurians*), and Caucasian prickly comfrey. "From the results obtained" it is inferred "that very few of these plants merit a second trial." Compared with silage corn grown near them, they were very inferior as forage crops. Several varieties of grasses and clovers were also grown.

BULLETIN No. 48 (STATION). APRIL, 1889.

HORTICULTURAL DEPARTMENT.*—POTATOES, KALE, SQUASHES, AND TOMATOES, L. R. TAFT, M. S. (pp. 3–27).—The observations of 1888 were confined for the most part to tomatoes, potatoes, kale, and hybridized squashes. Notes, weights, and photographs were taken and seeds saved. Frost and dry weather interfered with tests of other plants. The bulletin is illustrated with four plates, containing sixteen figures.

Potatoes (pp. 3–6).—The tests were confined almost entirely to nine varieties of seedlings sent for trial. The soil used in most of the experiments was very light, and the plants were badly injured by the drought. Notes regarding yield, appearance, quality, and promise of each variety are given. Special attention was given Pringle's Hybridized potatoes. Some of the seedlings of this variety were sent to persons in different parts of the State, and a portion of their reports are given.

Kale (pp. 6–8).—The nineteen varieties tested are described in more or less detail.

Cross-fertilization of squashes (pp. 8, 9).—From experiments begun in 1887 the conclusion is drawn "that, under normal conditions, the effect of a cross is confined to the seeds." The writer also states in substance that while no general rule ought to be deduced from experiments with one plant, yet no investigator has been able "to produce fruits in which the ovary walls or receptacle were affected by the pollen used."

Tomatoes (pp. 10–27).—The tests included 200 varieties or numbers. The results of the observations are given in tabular form.

(1) *Varieties recommended for planting.*—In general the smooth sorts are to be preferred to the angular. Of the latter, however, Extra Early or Cluster (Landreth) "will perhaps give best satisfaction." For the table and cooking, the apple-shaped sorts (Advance and Hathaway's Excelsior for early, and the Cardinal, Paragon, and Perfection groups are named) are recommended; for

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* Prof. L. H. Bailey had charge of this department until August, 1888. In the preparation of this bulletin Professor Taft was assisted by Mr. C. S. Crandall.

pickling and preserving any of the pear and plum varieties and Green Gage and White Apple will do well. "Of the yellow apple-shaped varieties, Jaune Grosse Lisse proved most satisfactory. Golden Queen or Yellow Jefferson will also be found desirable." Among the older varieties, Ignotum (a sport from Eiförmige Dauer) is especially commended.

(2) *Effect of using seeds from first ripe fruits.*—To test this matter, fifty-two varieties were planted in duplicate, six hills of each from seeds of first ripe fruits and the six adjoining hills from seeds selected some two weeks later. The results included in the tables are thus summarized in general terms:

> The first picking of tomatoes of angular varieties gave four times as many fruits from plants grown from seeds of the first ripe fruits as from those selected from the main crop, while with the apple-shaped sorts only two-fifths as many were obtained.

BULLETIN No. 49 (STATION), MAY, 1889.

CHEMICAL COMPOSITION OF CORN STALKS, HAY, AND SCREENINGS, R. C. KEDZIE, M. D. (pp. 3–8).—*Corn stalks and silage at different periods of growth* (pp. 3–7).

> The acreage food value of a fodder crop will be at its maximum when there is the largest amount of digestible albuminoids and carbohydrates and the least relative amount of indigestible fiber. The percentage of chemical composition, therefore, will have to be interpreted with reference to this acreage increase of the crop. The plan adopted for 1888 was to gather a specimen of corn as soon as it is tasseled, make a chemical analysis of a part, and place the balance in a silo for future analysis, and repeat this process every week until the corn was fully ripe. The fresh stalks were examined for the amount of water and dry matter at each cutting, and a quantity of the cut stalks was rapidly dried and saved for subsequent analysis.

Burrill and Whitman's silage dent corn was used. When harvested the corn was cut into pieces three-fourths of an inch long, and immediately placed in small silos, consisting of strong oak casks. These silos proved very satisfactory for the purpose. Two tables are given, one showing the condition of the stalks at time of ensiling and the percentage of dry matter in the stalks and in the silage, and the other the chemical composition of corn stalks and silage from the same lot, and also of some silage made from corn not fully matured. From the author's remarks in connection with the second table the following statements are gathered: (1) as the corn approaches maturity there is a marked increase in the percentage of nitrogen-free extract and a decrease in the percentage of crude fiber and ash. (2) In the silo there is a small loss of crude protein and a change of albuminoids to amides, a progressive decrease of acid, and a notable increase of the ether extract (fat, etc.).

Marsh hay and wheat screenings (pp. 7, 8).—This includes chemical analyses of a sample of marsh hay of mixed wild grasses (sedges) and of a sample of wheat screenings, consisting of broken grain, shrunken wheat, seeds of weeds, etc.

BULLETIN No. 50 (STATION), JUNE, 1889.

THE GRAIN PLANT-LOUSE, A. J. COOK, M. S. (pp. 3–6).—An account of the grain plant-louse (*Siphonophora avenæ*), the reasons for its being numerous this year, etc. The Station is now making "extensive and accurate experiments" regarding the advisability of using the kerosene and soap mixture as a remedy.

MINNESOTA.

Agricultural Experiment Station of the University of Minnesota.

Department of the University of Minnesota.

Location, Saint Anthony Park. Director, Edward D. Porter, Ph. D.*

BULLETIN No. 5, JANUARY, 1889.

INTRODUCTION, E. D. PORTER, PH. D. (p. 4).—The Station invites co-operation and suggestions as to lines of work, and will gladly receive specimens of grains, grasses, seeds, vegetables, insects, mineral waters, ores, etc., for examination.

CORN, ITS HABITS OF ROOT GROWTH, METHODS OF PLANTING AND CULTIVATING, NOTES ON EARS AND STOOLS OR SUCKERS, W. M. HAYS, B. S. A. (pp. 5–33).—This contains an account of observations and experiments made at the Station in 1888, combined with others made at Iowa Agricultural College, Ames, Iowa, in 1886, in De Kalb County, Illinois, in 1887, and elsewhere.

Habits of root growth † (pp. 5–16).—The prime object was to ascertain where in the soil the corn does its feeding. The corn experimented on in 1888 was grown in a rich sandy soil, composed of clay and loam, underlaid at a depth of about 4 feet with gravel, through which the roots could not penetrate. On one field some grains of corn were planted several feet apart near a water main, so that the roots might be washed out with a jet of water under pressure. Numerous corn roots were dug and examined at different stages of growth. The text is illustrated by diagrams showing the primary roots at the first harrowing; at the first, second, third, and fourth cultivating and late in the fall; root pruning by deep and shallow cultivation; the root hairs and "sucking cells;" the roots and stem just previous to tasseling; roots and lower part of a mature stalk in a dry year, etc. It is clearly shown that in the spring, when the surface soil is comparatively warm, moist, and rich in plant food, the roots of the lower whorls start out nearly horizontally and spread in this direction from 2 to 5 feet from the stalk, but as the upper soil grows dry they turn downward, attaining a length of from 3 to 8 feet or even more. The later roots from the nodes of the stalk higher up are much larger in diameter than the earlier ones at the start, but grow vertically downward and diminish in size. The larger diameter of these "brace roots" at the upper end enables them to aid more powerfully in keeping the stalk erect. The roots of the first two or three whorls often die before the stalk ripens, leaving the later and larger roots to supply the plant with nourishment. The feeding capacity of the root system depends on the number of active "sucking cells through which the plant food is absorbed." These cells are located on the few inches near the ends of all the primary and secondary roots. The secondary roots are very much more numerous than the primary, and have a much greater development near the surface of the soil, so that the principal part of the root system is above the depth of 12 inches.

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* Professor Porter resigned March 21, 1889, and Prof. N. W. McLain, LL. B., was elected in his stead.

† See observations on the roots of corn and other plants by Thiel, Nathusius, Wandtafeln: IV Serie, Bewurzelung: Thiel, Berlin, Parey

Application of these facts to the cultivation of corn (pp. 16–20).—The statements and diagrams serve to explain the practical applications of the observations reported to the cultivation of corn. They indicate that while it is desirable to clear away the weeds which take out of the soil nourishment needed by the useful plant, and while cutting the roots of the first shoots may have a tendency to make the mass of roots more compact, and deep cultivation may do some good by thoroughly stirring the soil, yet that on the whole such cultivation is to be preferred as will stir the soil thoroughly but not deeply enough to cut many corn roots, cut the weeds between the rows and cover those in the hill, hill the corn sufficiently to aid the upper roots in making a strong growth, and leave a "dust blanket" or "dirt mulch" 2 to 4 inches thick entirely across the space between the rows. One of the most serious objections to the deep cultivator shovel is that with it the thoughtless farm laborer, believing in "thorough tillage," and supposing that the more he loosens the soil under the corn the better work he is doing, cuts many roots and robs the plant of part of its means of feeding. Diagrams show how different cultivators leave the dirt and how they cut or do not cut the roots.

Field tests of deep vs. shallow culture (pp. 20–27).—Twenty-four one-tenth-acre plats were set apart for a trial of deep *vs.* shallow culture, to continue one or more years. Implements loaned by five manufacturers were employed. The corn was planted in hills and drills and with a lister (*i. e.* combined plow or "stirrer" of the stubble and corn planter). The plats were harrowed (those listed once, the others twice), and were cultivated four times. The effectiveness of each cultivator in keeping the several plats clean and the average yields per acre from the several ways of planting and cultivating are shown in tables, and comments are made on the advantages of each of the cultivators used. The results in 1888 were unfavorable to listing, but the experiments must be repeated before definite conclusions can be drawn.

Tests of root-pruning and hilling (pp. 27, 28).—Seven small plats were treated alike, except that on three of them, "after the last plowing, a knife was run around each hill at a depth of 6 inches, and 6 inches from the stalks." The yields of corn in the ear and of fodder are given. The root-pruned plats averaged nearly 3 bushels less of corn and 800 pounds less of fodder per acre than the unpruned. The results of another experiment were lost by accident.

General conclusions and suggestions (pp. 28–30).—These are drawn from the experiments above reported, from other experiments and observations by the author, and from the general practice of corn-growers. They apply in Minnesota, and include the following:

(1) Use proper rotations, including clover; economize manures; have good tillage and tile drainage.

(2) Before severe frost select well-developed seeds of largest dent variety sure to ripen (flint in northern part of the State); keep the seed dry through the winter; before planting soak the seed in solution of sulphate of copper ("blue stone") to prevent smut.

(3) Plow in fall, to furnish more available plant food; secure earlier and better seed bed, and relieve spring work; plow stubble 5 to 7 inches, clover and grass sod 4 to 5 inches deep; in spring the same depth or shallower. Make a fine seed bed 3 inches deep.

(4) Plant in hills or "check-rows," unless labor for hoeing drilled corn is very cheap, 2 to 4½ inches in depth, according as planting is early or late and soil wet (or compact) or dry (or very mellow).

Planting with two-horse corn planter is excellent; listing does not pay in Minnesota.

(5) Harrow the corn twice or more; one good harrowing is worth more than a fifth plowing. Give the last harrowing when the corn is 4 inches high.

(6) The cultivator should stir the soil well without breaking many roots.

(7) Seek to produce good dent and flint varieties, ripening early and capable of withstanding early frosts.

Branching of the corn plant (pp. 30–33).—In connection with experiments begun for studying the cross-fertilization of corn, notes were made on the habits of growth of the stem, ears, etc., of several varieties. The branching and stooling habits of Mercer flint corn and some abnormal forms of growth from other varieties are described in the text and illustrated by a diagram. Notes on cross-fertilization of corn are reserved for a future report.

GROWTH OF RUSSIAN WILLOWS AND POPLARS FROM HARD-WOOD CUTTINGS, S. B. Green, B. S. (pp. 34, 35).—A record of experiments with eight species of poplars and five of willows in the Station nursery in the spring of 1888. The cuttings were made from well-ripened wood of the preceding season's growth. Most of the varieties rooted well, but *Populus alba* entirely failed, as it had done in previous experiments. The method of cutting and planting is described and results showing amount of growth in feet and per cent of cuttings growing are stated in tabular form.

NATIVE PLUMS, S. B. GREEN, B. S. (pp. 36–38).—This representative fruit of the Northwest is well adapted to the climate of that section and is susceptible of much improvement under cultivation. It is to be expected that valuable crosses between this and finer but less hardy plums will be produced for growth in this region. The Station has made a collection of promising native varieties. Notes on plums grown at the Station in 1888 are given. In reference to the claim made for some varieties of plums that they are "curculio proof," it is stated that all varieties are liable to the attack of this insect, but that the native varieties are not so much injured by its attacks as the others.

TESTS OF VARIETIES OF CABBAGE, S. B. GREEN, B. S. (pp. 38–43).—Tests were made with common varieties and with some novelties, and the conclusion is that few of the new varieties are "any better, if as good, as those now grown and widely known." Notes are given on some old and new varieties deserving especial mention and on six varieties not true to name or mixed. Complete data for the varieties grown at the Station in 1888 are stated in tabular form.

EXPERIMENTS IN POTATO CULTURE, C. POUMEROULIE (pp. 44, 45).—The yields from sprouts grown in the natural way are compared with those from sprouts bent down with a hand roller when 1 foot high and covered with earth. The results in this case favor the use of the roller.

FROSTED AND RUSTED WHEAT, OTTO LUGGER, PH. D. (pp. 46–67).

Freezing of plants (pp. 46–53).—An account of the physiological changes in the plant during freezing. The Station has undertaken the investigation of this subject with reference to wheat by chemical analyses and by artificial and natural propagation of the frosted grain.

Rusting of wheat (pp. 53–67).—An illustrated account of the fungi causing rust, with a glossary of the technical terms used and a letter describing a visit of the author to the region in the Red River Valley where the wheat had been greatly injured by rust.

BULLETIN No. 6, FEBRUARY, 1889.

NOTES ON THE EFFECTS OF FROST AND RUST ON THE GERMINATION OF WHEAT, E. D. PORTER, PH. D. (pp. 5–9).—In September, 1888, a letter was received at the Station from the editor of "Farm, Stock and Home," asking for information regarding the effects of frosting on wheat. This led to an investigation of this subject by the Station. In response to an inquiry from the Station, Hon. J. S. Pilsbury, the well-known flour manufacturer, stated that frosted wheat produced flour of a very low grade and only one-fourth the quantity obtained from sound wheat. When farmers in the frosted districts did not generally respond to the request for samples of injured wheat, published in the paper referred to, the Station botanist visited that portion of the State most severely affected by August frost and collected samples there. Some of these were used for germination and field tests and chemical analyses, and the rest were reserved for the Station museum. The results of the chemical analyses and the field experiments will be given in a future bulletin. Diagrams illustrate plants of frosted and unfrosted wheat.

Experiments in germination and growth of damaged wheat and barley, S. B. Green, B. S. (pp. 11–28).—This article gives full details of observations on the germination and growth of some thirty-seven samples of frosted wheat and barley in prairie soil in boxes in a greenhouse. Among the points noted are character of grain (some of which was in extremely poor condition) as to source, grade, as determined by State inspectors, weight, proportion of kernels that germinated, growth and development of plants, and per cent of seed producing healthy plants. The difference between growing wheat in a greenhouse and in open ground is discussed, and letters from wheat-growers who examined the experiments are given. The results were unexpectedly favorable for the germination and growth of frosted grain. It must be noticed, however, that the conditions of growth in these experiments were more favorable than those usually found in the field. Farmers are advised to await further experiments before using frosted wheat for seed, especially in consideration of the magnitude of the interests at stake.

BULLETIN No. 7, APRIL, 1889.

Announcement (p. 4) of the resignation of Edward D. Porter, Ph. D., and the election of N. W. McLain, LL. B., as director of the Station.

Soil temperatures, E. D. Porter, Ph. D. (pp. 5–11).—Observations were begun January 1, 1889, with a set of ten soil thermometers. These instruments and the method of their arrangement are described. To make winter observations possible, gas pipes were set in the ground and the thermometers put in them. The source of error from having the thermometers in iron pipes rather than in the soil itself is referred to. Records of daily observations for January, February, March, and April are given, together with notes on the freezing and thawing of the soil. The average temperatures at depth of 3 inches for these months, in the order named above, were 25°, 19°, 41°, and 58°; at the depth of 5 feet, 38°, 34°, 33°, and 36°.

The soil at this Station, gravel and sand with a good admixture of clay, froze to a depth of more than 4 feet, though the winter was unusually mild.

Best varieties of corn for silage, E. D. Porter, Ph. D. (pp. 12–26).

Comparative tests of varieties (pp. 12, 13).—The tests were begun in 1887 (see Bulletin No. 2 and Annual Report for 1888, p. 90) and continued in 1888. One to five rows, 100 feet long, were planted with each variety, all being treated alike. Notes on the height, stage of growth, general appearance and distance apart of stalks in row were taken weekly. From the actual yield the corresponding yield in tons per acre was estimated. A table gives observations, including times of tasseling, silking, bloom, and stage of ripeness for eight varieties of white dent, seven of yellow dent, one of white flint, twelve of yellow flint, and sixteen of sweet corn. The chemical composition of the larger part of these varieties is also stated. The early varieties were cut at that stage known as "glazed," but some of the later, larger varieties had not reached that stage when harvested. As a rule the dent varieties yielded the most fodder and more dry matter than either flint or sweet varieties.

Southern vs. flint corn for silage—Field and feeding experiments (pp. 13–26).—On one half of an adjacent field of four acres a large variety of Southern white, and on the other half Mercer, one of the most prolific varieties of flint corn, was planted. Observations as to development and composition are included in the table above referred to. The Southern corn yielded 26.8 tons of corn fodder and 6.2 tons of water-free substance, *i. e.*, actual nutritive material exclusive of water; the flint corn, 13 tons of corn fodder and 4.4 tons of dry matter per acre. Feeding experiments were made to observe the relative value of the dry matter of the silage from these two kinds of corn. The flint corn was ensiled when in the glazing stage and had well-developed ears, estimated equivalent to 40 bushels of shelled corn per acre; the Southern corn when in the "early milky stage."

In one experiment four Holstein-Friesian cows were fed for milk, and in another six native and grade cows and heifers were fed for fattening. During the whole time the animals of each experiment were divided into two groups, one of which had cold water and the other warm. The silage was fed with enough timothy hay, bran, corn meal, and oil-cake to make a well-balanced ration. After a preliminary feeding all the cows were fed flint-corn silage and grain for a period of twelve days, then with Southern-corn silage and grain for a second period of twelve days, and finally flint-corn silage and grain for a third period of eight days. The three periods extended from March 9 to April 17. The details of the experiments are given in fifteen tables, showing age, time of last calving, and daily yield of milk prior to selection for each cow; chemical composition of the silage, estimated digestible nutrients and nutritive ratios, and compositions of rations fed each lot of cows during each period; weight of each cow at beginning and end of each period; water and feed consumed, milk given, and butter produced during each period. The inferred relative values of the two kinds of silage used for feeding, and incidentally the effects of the warm and cold water, are stated.

Results of feeding experiments (pp. 19–24).—In these trials, so far as the fattening of the cattle was concerned, as implied by the weighing, flint-corn silage gave better returns per acre than the Southern-corn silage. This was believed to be principally due to the larger amount of well-ripened ears in the former. For milk, the value of the dry matter of the two kinds of corn, as measured by the milk yield, was nearly equal, pound for pound, but the Southern corn produced one-third more dry matter in the silage per acre. The milch cows increased in weight on the average during the periods when they were fed flint-corn silage, and decreased in weight when fed Southern-corn silage, but the average daily milk yield was larger with the Southern than with the flint corn. The apparent advantages obtained by warming water in this, as in a previous experiment, were slight, and the author infers that it pays to warm the water only in very cold weather and for animals which are much exposed.

The time to cut corn for silage (pp. 24, 25).—Specimens of two varieties, Rustler, a medium-sized white dent variety, and Egyptian Sweet, a large, late, sweet variety, were cut at five different dates, from September 4 to September 24. During that period the dry matter in the dent variety increased from 11.4 to 19.7 per cent, and that in the sweet from 9.1 to 13.3 per cent.

General conclusions (pp. 25, 26).—These experiments were performed on a limited scale with a small number of cows, but the conclusions are strengthened by the fact that they are in line with the results of previous investigations at the Station. Among the inferences are the following:

(1) For silage it is well to grow those kinds of dent corn which are slightly too large to ripen in the locality, but which will become mature enough for this purpose or will reach the glazing stage. Far northward the largest flint varieties that will reach the glazing stage can be used for silage, thus pushing the corn belt far beyond its present limit.

(2) It was evidently more profitable to put ears of corn into the silo than to husk them and then handle the stalks as dry fodder.

(3) Silage has as much available nutriment as the same crop dry-cured, and its succulency gives it additional value for feeding with dry fodder.

(4) Corn silage should never be fed alone, nor in too large proportion when combined with other fodder. Silage and clover hay combined make a most excellent mixture for coarse fodder. These, with bran, shorts, corn meal, etc., in proper proportions, make the most economical food for young cattle and for making milk and beef in Minnesota.

(5) For twenty or even fewer cattle, it pays to preserve enough silage to furnish one-third of the dry matter of the winter's feed of the herd.

(6) Corn produces the most digestible feed if cut in the glazing stage or when the ends of the grains are beginning to harden.

IMPROVING CORN BY CROSS-FERTILIZATION AND BY SELECTION, W. M. HAYS, B. S. A. (pp. 27–33).—The fertilization of corn is explained, and the lack of attention paid to the selection of a "thorough-bred" seed is commented upon. Descriptions are given of experiments in "breeding" corn carried on in 1888. These are accompanied by pictorial illustrations, showing the appearance of ears in which artificial fertilization and crossing were effected with more or less success by covering the ears with bags of cloth or paper (preferably cloth) to prevent the access of pollen to the silk in the ordinary way.

The pollen from selected stalks was dusted upon the silks after these had reached the stage to receive it; the bags were then readjusted and left until all danger of other pollen entering had passed.

It is hoped that this line of investigation will lead to results of decided value.

Washing and salting butter, by W. M. Hays, B. S. A., and D. N. Harper, Ph. D. (pp. 34–42).—"This is a study of washing and salting butter, to compare the several methods of getting the milk or curd out and the salt in, and at the same time lose nothing of the flavors." In the experiments, which are described in detail, salt did not diffuse through or "strike into" the butter. When, however, the butter was in granular form, the salt was carried by water in continuous channels or interstices among the granules. Two lots of butter, one with small and the other with large granules, were placed in brine and gently stirred to bring the brine in contact with the granules. Portions of each lot were removed in one, five, and thirty minutes and immediately worked as nearly free of water as possible. Analysis showed that more salt was left in the butter when it remained in the brine some time, and about one-half more in the small-grained butter than in the large-grained. Other trials showed that by washing "granular" butter with the saturated brine a full amount of dissolved salt can be incorporated with the butter. It was also shown in the same way that (1) washing butter either with clear well-water or with brine did not remove nearly all the curd of the buttermilk; (2) water in the butter with very small granules contained relatively less cheesy matter; (3) the ash of butter was very much reduced by washing when in the granular form; (4) the curd must be carried out mechanically by the water. This process is materially assisted by considerable stirring. The relation between the solubility of salt in water and amounts of water and of salt in butter is discussed. The water normally contained in butter will hold in solution as much salt as is needed. In general, the smaller the separate particles of the butter when washed, the more early and completely is the curd washed out. Further results are to be reported.

Greenhouse walls—relative protective values of different methods of construction, S. B. Green, B. S. (pp. 43–50) (illustrated).—The wall of the greenhouse was divided into seven sections, forming as many kinds of wall, which are described and illustrated by a diagram. A tri-daily record was taken from thermometers hung inside of boxes attached to the inside of the different sections. The following conclusions were drawn:

(1) The brick wall with more than one air space was much warmer

than the lined board wall filled with sawdust, but the latter was as warm as the brick wall with one dead air space.

(2) The warmest brick wall was that made of brick and hollow tile with three air spaces.

(3) The hollow wooden wall with a brick veneer was warmer than the hollow brick wall.

(4) The hollow brick wall with a 5-inch air space was nearly as warm as the 13-inch solid brick wall.

(5) The warmest wooden wall was that made with the interior lining and filled with 4 inches of dried sawdust.

(6) The wall built of a single well-made wooden covering with tarred paper under the clapboards and inside was much colder than the same wall when well sheathed on the inside.

(7) Probably the cheapest warm wall for general farm purposes is one made of wood with a 4-inch air space filled with dry sawdust or some other good non-conducting material.

Experiments with potatoes, S. B. Green, B. S. (pp. 51–64).—This contains a record of a four-years' test of one hundred and eighty varieties of potatoes and a list of over one hundred and fifty other varieties considered unworthy of further experiment. Details are given in two tables with additional notes on varieties worthy of special mention. The tests seem to show that it is impracticable to grow the same variety year after year in Minnesota, and that the European varieties are not likely to be as good as the best kinds originating in this country.

The chemistry of wheat, D. N. Harper, Ph. D. (pp. 65–84).—The analyses here recorded were made to determine the effects of frost and rust on the chemical composition of wheat, and belonged to the investigation on wheat already partially reported in Bulletins Nos. 5 and 6. The article is introduced with an explanation of technical terms employed in the statement of analyses. Twelve samples of graded wheat and thirteen of ungraded were analyzed. The ungraded specimens were injured by frost and rust. Notes are given for each experiment on the grade (as established by the State grain inspection department), relative color and hardness, specific gravity and general appearance. The record of analyses includes percentages of water, water-free substance, ash, oil (fats, etc.), fiber, carbohydrates, protein, total and albuminoid nitrogen, and gluten. The term "gluten," as here used, includes different nitrogenous compounds of complex and not well-understood constitution, as well as variable quantities of fatty and mineral substances, etc. It is the material which gives tenacity to wheat flour. A method for determining approximately the quantity is described. Comparisons are made with analyses of other American and a few foreign wheats. The danger of basing conclusions upon too few observations is insisted upon.

Frosted and rusted wheat (pp. 77–84).—This includes chemical analyses of several samples of four varieties of "rusted and frosted" wheat. It was shown that—

(1) The physical characteristics of such wheat were abnormal, as well as the percentages of the chemical constituents.

(2) The "gluten" varied from none to 8.7 per cent in amount, and was of very poor quality.

(3) As compared with graded wheat, the "rusted and frosted" wheats contain about 2 per cent more protein, indicating "that they would be good for feeding purposes:" the percentages of water and carbohydrates were less, and those of ash, oil and fiber were greater than in the graded wheat.

(4) By comparing analyses of bran with those of "rusted and frosted" wheat, it appeared that rust or frost does not do the milling and leave only the bran.

MODERN FEEDING OF PIGS AND ITS INFLUENCE UPON THE FORMATION OF THE SKULL AND DENTITION, OLAF SCHWARTZKOPFF, V. D. S. (pp. 85–94).—During the past two years it has often been alleged by practical breeders in this country and Europe that modern feeding causes an earlier development and consequently an earlier shedding of the teeth of domestic animals. In 1882 Prof. G. T. Brown (see Journal of the Royal Agricultural Society) endeavored to show that the breeders were wrong, and that the old rules for determining age by dentition were generally reliable. A few years later the German government was induced by complaints of breeders to institute new experiments on this subject, and Prof. A. M. Nehring, of Berlin, published in the *Landwirtschaftliche Jahrbücher* for 1888 a series of new dentition tables for pigs, as a result of his studies and investigations upon a collection of one hundred and thirty-one skulls of different kinds of pigs at the Museum of the Royal Agricultural School at Berlin.

Dr. Schwartzkopff bases his article on the results of Professor Nehring's investigations, combined with his own observations and experience. Diagrams are given showing the influence of feeding and of breeding on the shape of the pig's skull. There are also diagrams, formulas, and a tabular statement of the dentition of the pig, with comments on the development of this animal. The conclusions are stated as follows:

(1) The order of succession of the teeth in our precocious pigs remains the same as in the primitive hog.

(2) The times when the teeth appear are variable, according to the race, feeding, and health. The same breeds, raised under the same conditions, will show the same appearance.

(3) The form of the skull depends upon nutrition, health, and the extent of employment of certain muscles of the head and neck.

MISSISSIPPI.

Mississippi Agricultural Experiment Station.

Department of Mississippi State Agricultural College.

Location, Agricultural College. Director, S. M. Tracy, M. S.

BULLETIN No. 6, JUNE 25, 1889.

Charbon, S. M. Tracy, M. S. (p. 1).—In June, 1889, this disease broke out among mules at Yazoo City. It was announced to the Station by telegrams that fifty deaths had occurred and that the animals attacked died within twenty-four hours. The acting veterinarian of the Station, Dr. G. C. Creelman, was at once sent to the place, and other experts were afterwards summoned. The results of the investigations have not yet been published. This preliminary bulletin describes the symptoms of the disease and suitable preventive treatment, and recommends that as soon as the first symptoms are noticed the animal should be drenched with the following mixture:

> One tablespoonful each of chlorate of potash and tincture of muriate of iron in a pint of water. Repeat this every four hours. Bathe the affected parts with crystallized carbolic acid, using one part acid to eight parts water. All sick animals should have pure air, and must be protected from rain and hot sun and provided with an abundance of good food. If the kidneys become affected, give one ounce doses of saltpeter in drinking water, and if the bowels are inactive give one-half ounce doses of linseed oil until relieved.

As soon as the animals die they should be burned and the place disinfected with carbolic acid or lime.

BULLETIN No. 7, JUNE 20, 1889.

Hay presses, S. M. Tracy, M. S. (pp. 2–12).—This describes competitive trials with hay-presses. The grading was made with a scale, in which the weight per cubic foot of bale, speed, horse-power, and appearance of finished bale were the principal factors.

MISSOURI.

Missouri Agricultural Experiment Station.

Department of Missouri Agricultural College.

Location, Columbia. Director, J. W. Sanborn, B. S.

BULLETIN No. 5, FEBRUARY, 1889.

Soil, weather, field trials with corn, P. Schweitzer, Ph. D. (pp. 4–44).—The study of the corn plant outlined in Bulletin No. 1 of this Station was planned to include a study of the soil and climatic conditions at the Station; chemical analyses of the different parts of the plant at different stages of development; studies on the physiology of the plant; and experiments in cultivation and with fertilizers. Bulletin No. 5 contains an account of the results thus far obtained in regard to soil, climatic conditions, and the growth of corn in the field.

The soil (pp. 4–14).—The portion of the college farm selected for experiment "represented a typical Missouri soil" of "bluff formation." Samples representing the surface soils to a depth of about ten inches and the subsoils at a depth of eighteen inches, and underlying, stiff, plastic clay from a depth of about 3 feet were analyzed. The composition of "air-dried soils," "ignited soils," and of the portion soluble in muriatic acid are stated from analyses and estimates based upon them. Results are briefly given without description of analytical methods. The transport of material by roots from subsoil to surface soil is discussed and its importance dwelt upon. The author is inclined to believe "that *superior tillage with the chemical and physical processes induced by it in the soil* is the key to the situation and one remedy for existing distress in agricultural pursuits."

The cause of the black color of the moist soil in that section is discussed, and its possible connection with the oxidization and deoxidization of compounds of iron is suggested. Under the head of physical properties of the soil, the porosity, and water-holding, water-lifting, and absorptive powers are treated.

Climatic conditions (pp. 14, 15, 35–44).—The temperature of the air and of the soil at 3 and 6 inches, and 1, 2, and 3 feet below the surface were recorded daily from May 5 to September 5, and the results embodied in a number of diagrams.

Field trials (pp. 16–34).—An account of experiments with corn in 1888 on a field of about 20 acres. The methods used in preparing the soil and planting and cultivating the crop are described, and a diagram of the experimental field is given. The details of the experiment are set forth in fourteen tables, showing yield of husked and shelled corn, the weight per measured bushel of shelled corn, weight of one ear, grain and cob, percentage of cob, number of kernels on one ear, the measurement of leaves of one corn plant July 9 (total leaf surface, including one side of sheath, was 3,480.66 square inches, or over 24 square feet), and the daily growth of five corn plants in inches from June 23 to July 26, inclusive.

BULLETIN No. 6.

EXPERIMENTS ON SEED GERMINATION, PEA-WEEVIL, AND APPLES, J. W. CLARK, B. S. (pp. 3–10).

Germination tests.—These included tests of the seeds of a considerable number of different kinds of vegetables, grasses, and clovers purchased from dealers. The average number of seeds germinating in each 100 tested was about 65.

Pea-weevil (*Bruchus pisi*).—A statement of a method of destroying this insect by soaking the peas in water before planting.

Apple tests.—Notes on the keeping qualities of twenty-one varieties of apples.

REPORT OF COMMITTEE ON MISSOURI AGRICULTURAL COLLEGE COLLECTION OF APPLES (exhibited at the annual meeting of the Missouri State Horticultural Society at Nevada, Mo.) (pp. 9, 10).—The committee commended the College for its exhibit of apples and for its experiments with new varieties of this fruit.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE, ISSUED IN 1889.

PART I.

BUREAU OF ANIMAL INDUSTRY.

HOG CHOLERA. D. E. SALMON (pp. 1-197).—This special report treats of the history, nature, and treatment of hog cholera, as determined by the inquiries and investigations of the Bureau of Animal Industry. In the letter of transmittal it is stated that in the course of the investigations two very different and distinct epizootic diseases of swine were discovered. One of these is called hog cholera.

Introduction and spread of hog cholera in the United States.—This chapter traces the development of the epizootic swine diseases from the first outbreak recorded in Ohio in 1833 up to 1887, and gives a tabulated statement of the replies from about 850 correspondents, showing when the original outbreaks occurred in their localities. It also gives extracts from papers by Dr. George Sutton, of Indiana, and Dr. E. M. Snow, of Rhode Island, showing the condition of the disease from 1856 to 1861.

The investigations of swine diseases.—A résumé of the scientific investigations of hog cholera, beginning with those of Dr. George Sutton, of Aurora, Ind., made from 1850 to 1858, and those of Dr. Edwin M. Snow, of Providence, R. I., published in 1861. The paper contributed by Prof. James Law to the Annual Report of the Department of Agriculture for 1875 is given in full. There is also a résumé of the early investigations of Dr. H. J. Detmers and a brief review of the investigations of Drs. Law, Detmers, and Salmon, published from 1878 to 1886.

Symptoms and post-mortem appearances in hog cholera.—These are stated in detail. The disease is divided into (a) the acute type, (b) the chronic form. The chapter closes with the history, autopsy, notes, and bacteriological observations of an outbreak of hog cholera near the city of Washington in 1887.

The causation or etiology of hog cholera.—The investigations led to the conclusion that the disease is caused by a bacillus.

The bacillus of hog cholera.—This bacillus has been obtained from about four hundred hogs affected with the disease during the past three years. It is found in largest numbers in the spleen. When stained in an aqueous solution of methyl violet, the bacteria appear as elongated ovals, or short rods, with rounded ends, chiefly in pairs. In cover-glass preparations from the spleen, when the staining has been very brief, only the border of the rods is deeply stained, the central portion being pale. When the period of staining is prolonged the rod may become uniformly stained. Bacteria thus prepared and mounted in balsam measure from 1.2 to 1.5 micro-millimeters in length and about 0.6 micro-millimeters in breadth. The germs have not been positively identified in the ulcers of the intestines by microscopical investigations, but their presence has been demonstrated by the inoculation of mice and rabbits.

Staining of hog-cholera bacteria.—Cover-glass preparations are stained by a few minutes' contact with watery solutions of the ordinary aniline colors, such as methyl violet, fuchsin, and methylene blue.

Distribution of bacteria in the body.—In acute cases the spleen contains the largest number, the liver nearly as many. The lungs, lymphatic glands, and kidneys contain a moderate number. They are fewest in the blood from the heart. In chronic cases the number in the internal organs is very small.

Biology of the hog-cholera bacillus.—This section gives the diagnostic characters as obtained by studying the growth of the bacillus in and on the different culture media.

The diagnosis of hog cholera by means of inoculation.—There are given here the results obtained by inoculating mice, rabbits, guinea-pigs, and pigeons with the bacilli of hog cholera.

Vitality of hog-cholera bacilli and their resistance to various destructive agents.—The vitality of these bacilli in cultures remains for months unchanged.

Resistance of hog-cholera bacteria to heat.—The bacilli are destroyed by momentary exposure to boiling water. The temperature of 136° F. to 138° F. destroys them when moist in fifteen minutes, and 130° F. in one hour. A dry heat of 176° F. destroys them in fifteen minutes. They retain their vitality after freezing.

Vitality of hog-cholera bacteria in ordinary water.—Experiments are given to show that these germs multiply for some days after they are placed in ordinary water, and that some of them retain their vitality for about two months.

Resistance to drying at ordinary temperature.—When culture liquids are dried upon cover-glasses and upon threads the bacilli lose their power of multiplying in from ten to fifty days. When small bits of spleen tissue were rubbed on cover-glasses and dried the germs were capable of multiplying for four months. When a moist and dry state alternated the germs which resisted drying four months were destroyed in less than one month.

Length of time during which virus remains alive in the soil.—A number of experiments were made by infecting soil and inoculating rabbits from this at short intervals. These experiments indicate that the virus lost its vitality in from one to four months.

Effect of disinfectants on the virus of hog cholera.—A large number of experiments are recorded. The method was to add a few drops of culture liquid containing the germs to the disinfectant solution in a sterilized watch-glass under a bell glass. After certain regular intervals of time platinum loops holding about one one-hundredth cubic centimeter were used to transfer this liquid to tubes of beef infusion. These were then placed in a thermostat and watched for a number of days; if no growth resulted, the bacilli were considered to have been destroyed. Results were briefly as follows: A saturated solution of common *salt* destroyed the bacilli in from twenty-one to twenty-nine days; *mercuric chloride*, 1 to 75,000, in seven days; *carbolic acid*, 1 to 80, in five minutes; *iodine* water in fifteen minutes; *permanganate of potash*, 1 to 5,000, in fifteen minutes; *mercuric iodide*, 1 to 1,000,000, in ten minutes; *sulphate of copper*, 1 to 200, in five minutes; 1 to 1,000, in twenty minutes; *hydrochloric acid*, 1 to 500, in five minutes; *chloride of zinc*, 1 to 10, in fifteen minutes; *sulphuric acid*, 1 to 2,000, in ten minutes. A mixture of equal parts of *crude carbolic acid* and *commercial sulphuric acid*, 1 to 200, destroyed the bacilli in mixtures containing much organic matter in one hour. Ordinary *lime* destroyed the bacilli in water when present in only 0.03 per cent; in beef infusion, when there was 0.08 per cent, and when there was considerable albuminous matter in suspension it required 0.32 per cent. It is concluded from other experiments that from 0.75 per cent to 1 per cent of *lime* will destroy the hog cholera bacilli in soil.

Is there any spore state in the life history of the bacillus of hog cholera?—This question is considered from various points of view, and is decided in the negative.

Ways in which swine become infected.—Experiments are detailed, showing the infection of hogs by feeding on the viscera of infected animals, and on pure cultures of hog-cholera bacillus, by subcutaneous inoculation with blood from affected swine and with culture liquids, and by intravenous inoculation.

Observations on the action of hog-cholera bacteria.—Under this head an explanation is given of the ways in which the different symptoms and lesions are produced in this disease.

Bacteriological investigation of hog cholera in Nebraska, Illinois, and Maryland.—This contains details in regard to the isolation and study of the hog-cholera germs from these different sections. While some slight differences in the manner of growth of the germ were observed, it was plain that they were all of the same species.

Relation of hog cholera to the public health.—The hog-cholera bacillus resembles in some respects the germ of typhoid fever, but the conclusion is reached that the two diseases are entirely distinct. Anatomically, hog cholera and diphtheritic dysentery are much alike, though there is no evidence that the latter disease can be produced by hog-cholera germs. The preparation of pork by cooking is sufficient to destroy the bacilli if by any chance the flesh of diseased animals gets into the market. The carcasses of hogs which have died should not be allowed to decompose on the surface of the ground near dwellings or streams of water, as this is dangerous to the health of the community, not because of the specific contagion, but from the decomposition of organic matter.

Prevention of hog cholera.—The sources and channels of infection are as follows:

(*a*) Pigs purchased from infected herds or coming in contact with those from infected farms, or running over grounds occupied by diseased swine within two or three months.

(*b*) Infected streams may communicate the disease to herds below the source of infection.

(*c*) Virus may be carried in feed, implements, and on the feet and clothing of persons from infected herds and premises.

(*d*) Winds, insects, birds (particularly buzzards), and various animals may transport hog-cholera virus.

When hog cholera has appeared in a herd the following precautions should be taken to prevent the virus from being carried to other farms or other herds:

(*a*) The dead animals should be immediately disposed of, either by burial or by burning, or if they are taken to some rendering establishment their transportation should be governed by well-defined rules which will prevent the dissemination of virus on roads, in wagons, etc.

(*b*) Streams should be carefully protected from pollution.

(*c*) No animals should be removed from any infected herd or locality to another free from the disease for at least six months after the last case of disease.

In order to prevent the remaining healthy animals of an infected herd from taking the disease the following measures are suggested:

(*a*) Removal of still healthy animals to inclosed uninfected ground or pens, as far as possible from infected localities.

(*b*) Destruction of all diseased animals.

(*c*) Careful burial or burning of carcasses.

(*d*) Repeated, thorough disinfection of the infected premises.

(*e*) Great cleanliness, both as to surroundings and as regards the food, to prevent its becoming infected.

Extended details are given under each of these heads.

Treatment of hog cholera.—There is no known specific for this disease and no specially successful treatment has been discovered. Experiments were made to obtain some safe and efficient laxative to use at the beginning of the disease, but in most cases the cathartics that were administered failed to produce this effect. Easily digested food, such as milk and gruel, is indicated.

Experiments on the prevention of hog cholera by inoculation.—Under this head are given the results of experiments, with no attempt to discuss the general economic value of vaccination in such diseases.

Inoculation with small doses of strong virus in the form of liquid cultures.—A considerable number of experiments show that a dose of one-fifth cubic centimeter of culture liquid may be injected hypodermically without danger to the life of the animal. After the effects of the inoculation have passed, a larger dose, reaching 2½ to 3 cubic centimeters, may also be given in the same way without danger. Most animals thus inoculated contracted hog cholera when they were afterwards exposed either by feeding or by cohabitating with diseased pigs.

Effect of feeding small quantities of cultures.—A number of pigs were fed with from 10 to 100 cubic centimeters of culture liquid. These animals were more or less affected by the feeding, but none died. When they were afterwards placed in an infected pen all contracted the disease and died. There was a marked difference between the pigs which had been fed and the check animals, in that the latter died of most severe hemorrhagic type of the disease, while the former succumbed to chronic infection.

Injection of sterilized culture liquid to produce immunity.—The oldest experiments were made in 1885 and 1886 with pigeons, and were continued in 1887. They show that these birds could be made insusceptible by such treatment. A considerable number of tests with sterilized cultures were made upon pigs, but without any uniformly favorable result, although in some cases there appeared to be more or less immunity produced in this way.

Experiments on the attenuation of hog-cholera bacilli by heat.—These experiments indicate that the pathogenic power of the bacilli expires only with their lives. The attempts therefore at attenuation were not successful, but they were being continued at the time the report was written.

Hog cholera, or diseases closely allied to it, in other countries.—Under this head is given a condensed summary of literature relating to the swine fever of Great Britain, a disease of swine in Denmark resembling hog cholera, and also outbreaks in France believed to be of the same nature.

REPORT ON EPIZOOTIC DISEASES AMONG SWINE, BY THE UNITED STATES BOARD OF INQUIRY (pp. 5–15).—This board, consisting of Dr. E. O. Shakespeare, of Philadelphia, Pa.; Dr. T. J. Burrill, of Champaign, Ill., and Dr. B. Meade Bolton, of Columbia, S. C., was appointed by the Commissioner of Agriculture to decide certain contested questions in regard to swine diseases and as to the accuracy of the scientific work of the Bureau of Animal Industry. The board visited Washington, D. C., Columbia, S. C., Lincoln, Nebr., Lexington, Ky., and Columbus, Ohio. There are two reports, one signed by Dr. Shakespeare and Professor Burrill, and one by Dr. Bolton, who found it necessary to submit his report before the completion of that of his colleagues. In both reports it was concluded that there were two epizootic diseases of swine in this country, which had been described in the Reports of the Bureau of Animal Industry as hog cholera and swine plague, respectively.

In both reports the opinion is expressed that the germs of each of these diseases were first accurately described and the proof of their pathogenic relations given in the Annual Reports of the Bureau of Animal Industry. The work of this Bureau is spoken of as up to the standard of modern requirements concerning bacteriological investigations. The board is of the opinion that the disease investigated by Dr. Billings in Nebraska and Dr. Detmers in Ohio is identical with the hog cholera described in the Reports of the Bureau.

The experiments concerning immunity are regarded as inconclusive and more or less indefinite. Yet it was found that there was a certain degree of protection afforded by inoculation and by feeding hogs with the virulent cultures. Inoculation with the living germs of the disease, either through the stomach or by hypodermic inoculation, is considered very objectionable, as it involves a serious risk of more widely extending the disease and increasing instead of diminishing the already enormous losses therefrom. Further investigations are advised with the chemical products of the disease germs in the hope that a safe method of producing immunity may be discovered.

DIVISION OF ECONOMIC ORNITHOLOGY AND MAMMALOGY.

BULLETIN No. 1.

The English sparrow in North America, C. H. Merriam and W. B. Barrows (pp. 405).—This bulletin gives in condensed form the results of an investigation begun in 1884 by a committee of the American Ornithologists' Union, continued by the Department of Agriculture in 1886, and completed in 1888. The abundant material upon which the report is based was derived principally from three sources: (1) The original observations and reports of more than three thousand correspondents in all parts of America; (2) the published testimony of naturalists and others in all parts of the world; (3) studies of the food-habits of the sparrow, and examinations of large numbers of stomachs by specialists connected with the Department of Agriculture.

A history of the various introductions of the sparrow to America is given; the rapid increase of the pest is measured, and its distribution is traced and mapped. Then are considered successively the different methods of its distribution, together with the various checks, both natural and artificial, which have affected it from time to time. The next five chapters treat respectively of injuries to buds, blossoms, and foliage; to fruits, garden seeds, and vegetables; to grain; of the relation of the sparrow to native birds; and of its relation to insects. In dealing with all these questions the utmost care is taken to state fairly and fully both sides of the question, and testimony from unimpeachable sources is introduced freely throughout the book. It is shown conclusively that the damage to agricultural products is immense, far exceeding all possible benefits conferred by the sparrow; that its presence seriously lessens the number of native birds; and that the good it does by eating injurious insects is insignificant as compared with the damage done on every hand.

Methods of restriction and extermination are discussed at length; bounties are shown to be inefficient; the use of poison is advocated; and full directions are given for poisoning, shooting, and trapping. A careful summary of existing statutes follows, and recommendations for future legislation are made. Then follow 160 pages of evidence in detail, and the volume concludes with a copious index and a colored map showing the distribution of the sparrow in North America at the end of the year 1886.

NORTH AMERICAN FAUNA, NOS. 1 AND 2.

Under the above title two numbers of a strictly scientific character have been published, the first containing a revision of the North American Pocket Mice, and the second, descriptions of new North American Mammals, with revisions of groups.

DIVISION OF FORESTRY.

BULLETIN No. 3, FEBRUARY, 1889.

THE USE OF METAL TRACK ON RAILWAYS AS A SUBSTITUTE FOR WOODEN TIES, E. E. R. TRATMAN, C. E., AND B. E. FERNOW (pp. 7–56).—This is a preliminary report on the use of metal railroad ties as a substitute for wooden ties in foreign countries and on other kindred matters. A full report on the same subject is to be issued soon. It is estimated that there are not less than 10,000 miles of metal track of various types in the world, the lion's share (5,530 miles) belonging to Germany. India has about 1,800 miles; the Argentine Republic over 1,000 miles; Austria, Switzerland, and Spain, 200 to 250 miles each; Holland and Belgium, 125 miles each; and England, France, Africa, Egypt, Algeria, Mexico, and other countries smaller amounts. In the United States only insignificant trials without definite results are reported.

Some 256 patents relating to metal railway track are briefly noticed and a few varieties of metal ties are more fully discussed. About 730,000 of the "Post ties," which originated in Belgium, are in use. Mr. Post, engineer of the Netherlands State Railway, in a paper on "Maintenance Expenses," which is reprinted in this bulletin, states that the cost of maintenance per kilometer per day ranges for periods of seven years from 0.407 to 0.952 francs, while oak ties had cost 0.605 francs. From Algeria it is reported that the use of metal ties (over 100,000) had saved one-fourth of the labor otherwise required for maintenance, or about $60 per mile per annum.

REPORT OF EXPERIMENTS IN WOOD SEASONING. G. H. ELLIS (pp. 57–67).—This was prepared by the chemist of the Chicago, Burlington and Quincy Railroad Company.

The result of this series of experiments shows that the month during which the seasoning begins varies with the kind of wood.

(1) That for oak the seasoning commences in March or April; with pine the exact month could not be decided, as it was not placed under observation until late (April), but all test pieces showed a loss of moisture within a fortnight after being exposed.

Ash and whitewood commenced to lose moisture in April, and elm immediately on being exposed, in January.

No law can be deduced from the experiments as to the exact time that seasoning ends, as the woods all vary; but as a general rule it may be stated that in all woods (except perhaps elm) seasoning virtually ends with the end of the summer months.

(2) All woods take up moisture in slight amounts during wet weather of the fall and winter months.

(3) Pine of small dimensions (such as 1-inch flooring) will absorb moisture during the wet months.

(4) As shown by these experiments, one season of average weather is generally sufficient to season woods for purposes of construction.

RELATION OF RAILWAYS TO THE TIMBER RESOURCES OF THE UNITED STATES. E. E. R. TRATMAN, C. E. (pp. 68–73).—This is a paper which was read before the American Forestry Congress at Atlanta, Ga., December 8, 1888. Four ways in which the railways may help to economize the timber supply of the country are discussed, viz: (1) By taking more care in the selection, cutting, and storing of timber; (2) by the more general use of iron, steel, stone, brick, concrete, etc., for bridges, trestles, buildings, and other construction works; (3) by the introduction of some efficient and economical preservative process; and (4) by the introduction of metal cross-ties. The necessity for devices to prevent the burning of forests by fires kindled by locomotives is also urged.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

AUGUST 15 TO NOVEMBER 15, 1889.

Report of the Secretary of Agriculture for 1889.

OFFICE OF EXPERIMENT STATIONS:

* Doc. No. 17, Experiment Station Bulletin No. 2, Part 1.—Digest of Annual Reports of the Agricultural Experiment Stations in the United States for 1888; issued June, 1889.

* Doc. No. 19, Experiment Station Bulletin No. 3.—Report of Meeting of Horticulturists at Columbus, Ohio; issued July, 1889.

Doc. No. 20, Circular No. 12.—Regarding the library and publications of the Office of Experiment Stations; issued October 8, 1889.

Doc. No. 21, Circular No. 11.—Rules for naming vegetables; issued September, 1889.

* Doc. No. 22, Experiment Station Record No. 1; issued September, 1889.

Doc. No. 23, Circular No. 13.—Letter urging attendance of station workers at the convention of American Agricultural Colleges and Experiment Stations; issued October 16, 1889.

Doc. No. 24, Circular No. 14.—Letter announcing meeting of Official Economic Entomologists; issued October 28, 1889.

BUREAU OF ANIMAL INDUSTRY:

Report of the United States Board of Inquiry concerning Epizootic Diseases among Swine.

DIVISION OF STATISTICS:

Report No. 66, new series, September, 1889.—Condition of Crops in America and Europe.

Report No. 67, new series, October, 1889.—Condition of Crops; Yield of Grain per Acre.

DIVISION OF ENTOMOLOGY:

Periodical Bulletin, vol. II, Nos. 2, 3, 4, and 5.—Insect Life.

DIVISION OF CHEMISTRY:

Bulletin No. 13, Part V.—Baking Powders.

Bulletin No. 22.—Record of Experiments at Des Lignes Sugar Experiment Station, Baldwin, La.

Bulletin No. 23.—Record of Experiments at the Sugar Experiment Station on Calumet Plantation, Pattersonville, La.

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* The asterisk indicates that the document is sent on application. The other documents of this Office are issued in very limited editions for special purposes, and are not of general interest.

SECTION OF VEGETABLE PATHOLOGY:

Circular No. 8.—Experiments in the Treatment of Pear Leaf Blight and Apple Powdery Mildew.

Quarterly Bulletin, June and September, 1889, vol. 5, Nos. 2 and 3.—Journal of Mycology.

DIVISION OF ORNITHOLOGY AND MAMMALOGY:

North American Fauna No. 1.—Revision of the North American Pocket Mice.

North American Fauna No. 2.—Descriptions of fourteen new species and one new genus of North American Mammals.

LIST OF STATION BULLETINS OF 1889 RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

AUGUST 15 TO NOVEMBER 15, 1889.

ALABAMA.

Canebrake Agricultural Experiment Station:

Bulletin No. 5, July, 1889.—Oats; Wheat; Meteorological Report.

CALIFORNIA.

Agricultural Experiment Station of the University of California:

Bulletin No. 83, November, 1889.—The Rise of the Alkali in the San Joaquin Valley.

COLORADO.

Agricultural Experiment Station of Colorado:

Bulletin No. 9, October, 1889.—Soils and Alkali.

CONNECTICUT.

Storrs School Agricultural Experiment Station:

Bulletin No. 5, October, 1889.—Atmospheric Nitrogen as Plant Food.

FLORIDA.

Agricultural Experiment Station of Florida:

Bulletin No. 6, July, 1889.—Department of Chemistry.

ILLINOIS.

Agricultural Experiment Station of the University of Illinois:

Bulletin No. 6, August, 1889.—A Bacterial Disease of Corn.

INDIANA.

Agricultural Experiment Station of Indiana:

Bulletin No. 27, August, 1889.—Field Experiments with Wheat.

Bulletin No. 28, September, 1889.—Smut of Wheat and Oats.

IOWA.

Iowa Agricultural Experiment Station:

Bulletin No. 6, August, 1889.—Wheat and Oats: Feeding Experiments; Habits of Striped Prairie Squirrel.

KENTUCKY.

Kentucky Agricultural Experiment Station:

Bulletin No. 20, July, 1889.—Commercial Fertilizers.

Bulletin No. 21, September, 1889.—Wheat Experiments; The Grain Louse.

LOUISIANA.

State Experiment Station:

Bulletin No. 24.—Rice and its By-Products.

MAINE.

Maine State College Agricultural Experiment Station:

Bulletin No. 1, second series, May, 1889.—Analyses of Commercial Fertilizers.

Bulletin No. 2, second series.—The Apple Maggot.

MARYLAND.

Maryland Agricultural Experiment Station:

Bulletin No. 4, March, 1889.—Experiment Orchard.

Bulletin No. 5, June, 1889.—Horticultural Department and Field Experiments.

MASSACHUSETTS.

Hatch Experiment Station of the Massachusetts Agricultural College:

Bulletin No. 6, October, 1889.—Greenhouse Heating; Strawberries; Fungous Diseases of Plants.

MICHIGAN.

Experiment Station of Michigan Agricultural College:

Bulletin No. 52, July, 1889.—Commercial Fertilizers.

Bulletin No. 53, August, 1889.—Spraying with the Arsenites.

MINNESOTA.

Agricultural Experiment Station of the University of Minnesota:

Bulletin No. 8, July, 1889.—Siloing Clover; Manures; Wheat; Locusts.

MISSISSIPPI.

Mississippi Agricultural Experiment Station:

Bulletin No. 5, May, 1889.—Fertilizers.

Bulletin No. 8, August, 1889.—Stock Feeding.

Bulletin No. 9, August, 1889.—Diseases of Sheep and Calves.

Bulletin No. 10, October, 1889.—Dishorning.

MISSOURI.

Missouri Agricultural Experiment Station:

Bulletin No. 7.—Experiments, Green *vs.* Dry Fodder.

Bulletin No. 8.—Experiments, Feeding Ensilage *vs.* Dry Fodder.

NEVADA.

Nevada Agricultural Experiment Station:

Bulletin No. 4, March, 1889.—Meteorological Report.

Bulletin No. 5, June, 1889.—Meteorological Report.

NEW YORK.

Cornell University Agricultural Experiment Station:

Bulletin No. 8. August 1889.—Effect of Different Rations on Fattening Lambs.

Bulletin No. 9. September. 1889.—Windbreaks in their Relations to Fruit-Growing.

NORTH CAROLINA.

North Carolina Agricultural Experiment Station:

Bulletin No. 64. July, 1889.—Stock Feeding on Scientific Principles.

OHIO.

Ohio Agricultural Experiment Station:

Bulletin No. 10, second series, vol. 2. No. 3. June, 1889.—Silos and Ensilage.

Bulletin No. 11. second series, vol. 2. No. 4. July, 1889.—Experiments with Fruits.

Bulletin No. 12, second series. vol. 2, No. 5. August. 1889.—Experiments with Wheat.

Bulletin No. 13. second series. vol. 2. No. 6. September, 1889.—Remedies for Injurious Insects and Potato-Rot.

PENNSYLVANIA.

The Pennsylvania State College Agricultural Experiment Station:

Bulletin No. 8. July, 1889.—Testing New Varieties; Germination Tests.

RHODE ISLAND.

Rhode Island State Agricultural Experiment Station:

Bulletin No. 1. March. 1889.—Organization.

SOUTH CAROLINA.

South Carolina Agricultural Experiment Station:

Bulletin No. 6. new series 2. July. 1889.—Hog Cholera.

TENNESSEE.

Tennessee Agricultural Experiment Station:

Special Bulletin. September. 1889.—The Army Worm.

VERMONT.

Vermont State Agricultural Experiment Station:

Bulletin No. 15. June, 1889.—Effect of Fertilizers on Composition of Corn; Analysis of Hay.

Bulletin No. 16. July. 1889.—Testing Milk at Creameries.

VIRGINIA.

Virginia Agricultural Experiment Station:

Bulletin No. 1.—Application of Fertilizers to Wheat.

Bulletin No. 2. October. 1889.—Experiment Orchard; Small Fruits.

WISCONSIN.

Agricultural Experiment Station of the University of Wisconsin:

Bulletin No. 21. October, 1889.—Comparative Value of Warm and Cold Water for Milch Cows in Winter.

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29

U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

W. O. ATWATER, DIRECTOR

EXPERIMENT STATION RECORD

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TABLE OF CONTENTS.

Page.
Editorial notes ---------- 117
Statistics of the stations ---------- 117
Abstracts of station bulletins, January–June, 1889, Part III ---------- 120
NEBRASKA:
Agricultural Experiment Station of Nebraska ---------- 120
Bulletin No. 5, January, 1889 ---------- 120
On certain injurious insects of the year 1888, L. Bruner ---------- 120
Bulletin No. 6, March, 1889 ---------- 120
Report of progress, including a history of the fields and description of the animals available for experimentation, H. H. Wing, B. Agr ---------- 120
Field experiments and observations for the year 1889, J. G. Smith, B. S ---------- 121
Grasses, clovers, and other forage plants ---------- 121
Corn ---------- 122
Oats ---------- 122
Wheat ---------- 122
Potatoes ---------- 122
Vegetables ---------- 122
Miscellaneous plants ---------- 123
Observations on soil temperatures ---------- 123
Rain-gauges ---------- 123
Meteorological report for 1888, D. B. Brace, Ph. D., and F. F. Almy ---------- 123
Bulletins Nos. 7, 8, 9, 10, June, 1889 ---------- 123
Original investigations of cattle diseases in Nebraska, 1886–1889, F. S. Billings ---------- 123
Southern cattle plague and yellow fever ---------- 123
The corn stalk disease in cattle ---------- 124
The so-called hydrophobia in cattle ---------- 125
Contagious inflammation of the cornea in cattle ---------- 125
A singular disease in the external sexual organs of cows ---------- 126
NEVADA:
Nevada Agricultural Experiment Station ---------- 127
Bulletin No. 5, June, 1889 ---------- 127
Meteorological report for April, May, and June, 1889, W. S. Devol, B. Agr ---------- 127
NEW HAMPSHIRE:
New Hampshire Agricultural Experiment Station ---------- 127
Bulletin No. 5, March, 1889 ---------- 127
Fertilizers and fertilizing materials, G. H. Whitcher, B. S ---------- 127
Bulletin No. 6, April, 1889 ---------- 127
Experiments with fertilizers, G. H. Whitcher, B. S ---------- 127
Use of farm manures ---------- 127
Commercial fertilizers ---------- 127
Soil tests on Station farm ---------- 128
Farm manures *vs.* artificial fertilizers ---------- 128
Effect of fertilizers on vegetation ---------- 128
Practical conclusions ---------- 129
Bulletin No. 7, May, 1889 ---------- 130
Test of dairy apparatus, G. H. Whitcher, B. S ---------- 130

NEW JERSEY: Page.

- *New Jersey State and Agricultural College Experiment Stations* 130
  - Bulletin No. 52, March 20, 1889 130
    - The worst needs of New Jersey, B. D. Halsted, Sc. D 130
  - Bulletin No. 53, March 26, 1889 131
    - Prices of nitrogen, phosphoric acid, and potash, G. H. Cook, LL. D 131
  - Bulletin No. 54, March 27, 1889 131
    - Potash as a fertilizer, E. B. Voorhees, M. A 131
  - Special Bulletin C, April 8, 1889 134
    - Pollen as affected by rain, B. D. Halsted, Sc. D 134
  - Special Bulletin D, April 9, 1889 134
    - Memoranda about cranberry insects, J. B. Smith 134
  - Special Bulletin E, April 13, 1889 134
    - Oyster interests of New Jersey, J. Nelson, Ph. D 134

NEW YORK:

- *Cornell University Agricultural Experiment Station* 134
  - Bulletin No. 5, April, 1889 134
    - On the production of lean meat in mature animals, I. P. Roberts, M. Agr 134
    - Does heating milk affect the quantity or quality of butter? I. P. Roberts, M. Agr 135
  - Bulletin No. 6, June, 1889 135
    - On the determination of hygroscopic water in air-dried fodders, W. P. Cutter, B. S 135
    - The determination of nitrogen by the azotometric treatment of the solution resulting from the Kjeldahl digestion, W. P. Cutter, B. S 136
    - Fodders and feeding stuffs, W. P. Cutter, B. S 136

NORTH CAROLINA:

- *North Carolina Agricultural Experiment Station* 136
  - Bulletin No. 61½, February 12, 1889 136
    - Fertilizer analyses 136
    - Seed examination for planters 136
  - Bulletin No. 62, February 28, 1889 136
    - Fertilizer analyses and the fertilizer control for 1889, H. B. Battle, Ph. D 136
  - Bulletin No. 62½, March 27, 1889 137
  - Bulletin No. 63, June, 1889 137
    - Tests of seeds, G. McCarthy, B. S 137
    - Rust on wheat and cotton 138
    - Does stable manure in drying lose any of its ammonia? F. B. Dancy, A. B 138
    - Analyses of commercial fertilizers and Pamunkey marl phosphate, H. B. Battle, Ph. D 138

OHIO:

- *Ohio Agricultural Experiment Station* 138
  - Bulletin Vol. II, No. 1 (second series), March, 1889 138
    - Entomology, C. M. Weed, M. S 138
  - Bulletin Vol. II, No. 2 (second series), April and May, 1889 139
    - Colic of horses, H. J. Detmers, M. V. D 139
  - Bulletin Vol. II, No. 3 (second series), June, 1889 139
    - Silos and silage, J. F. Hickman, M. A. S 139
    - Silage *vs.* field beets as food for milk production, C. E. Thorne and J. F. Hickman, M. A. S 141

Page.

OREGON:

Oregon Experiment Station 142
Bulletin No. 2, January, 1889 142
Horticultural—Preparation and notes on proposed work, E. R. Lake, M. S. 142

PENNSYLVANIA:

The Pennsylvania State College Agricultural Experiment Station 142
Bulletin No. 6, January, 1889 142
Tests of varieties of wheat, oats, barley, potatoes, and forage crops, W. H. Caldwell, B. S. 142
Bulletin No. 7, April, 1889 143
Tests of varieties of corn, W. H. Caldwell, B. S. 143
Analysis and valuation of fertilizers, W. Frear, Ph. D. 145

RHODE ISLAND:

Rhode Island State Agricultural Experiment Station 145
Bulletin No. 1, March, 1889 145
Organization, C. O. Flagg, B. S. 145
Bulletin No. 2, June, 1889 146
The Station Farm, C. O. Flagg, B. S. 146

SOUTH CAROLINA:

South Carolina Agricultural Experiment Station 146
Bulletin No. 4 (new series), January, 1889 146
Report of botanist and entomologist, G. F. Atkinson, Ph. B. 146
Bulletin No. 5 (new series), April, 1889 146
Field experiments with oats and wheat, J. M. McBryde, Ph. D. 146
Fertilizers on oats 147
Special nitrogen experiments 147
Special phosphoric acid experiments 147
Fertilizers on wheat 148
Tests of varieties of oats and wheat 148

TENNESSEE:

Tennessee Agricultural Experiment Station 148
Bulletin Vol. II, No. 1, January, 1889 148
Notes on fertilizers and fertilizing materials, W. E. Stone, Ph. D. 148
Bulletin Vol. II, No. 2, April, 1889 150
Diseases of the Irish potato, F. L. Scribner, B. S. 150
Potato Rot (*Phytophthora infestans*) 150
A new disease of the Irish potato 150

TEXAS:

Texas Agricultural Experiment Station 151
Bulletin No. 5, March, 1889 151
Creameries for Texas, F. A. Gulley, M. S., and G. W. Curtis, M. S. A. 151
Some points in butter making 151
Bulletin No. 6, June, 1889 152
Feeding experiments, F. A. Gulley, M. S. 152

VERMONT:

Vermont State Agricultural Experiment Station 155
Bulletin No. 14, March, 1889 155
Analysis of fertilizers licensed for sale in Vermont for the year 1889, W. W. Cooke, M. A. 155
Bulletin No. 15, June, 1889 156
Effect of fertilizers on the composition of corn, W. W. Cooke, M. A. 156
Analysis of hay, W. W. Cooke, M. A. 157

VIRGINIA: Page.

- *Virginia Agricultural and Mechanical College Experiment Station* 158
    - Bulletin No. 1, 1889 158
        - Field experiments with fertilizers on wheat 158

WEST VIRGINIA:

- *West Virginia Agricultural Experiment Station* 160
    - Bulletin No. 4, March, 1889 160
        - The creamery industry: its adaptability to West Virginia, A. C. Magruder, B. S 160
    - Bulletin No. 5, June, 1889 161
        - The selection of milch cows, A. C. Magruder, B. S 161

WISCONSIN:

- *Agricultural Experiment Station of the University of Wisconsin* 161
    - Bulletin No. 18, January, 1889 161
        - The constitution of milk and some of the conditions which affect the separation of cream, S. M. Babcock, Ph. D 161
            - Milg fibrin 162
    - Bulletin No. 19, April, 1889 164
        - Introduction—Notes on silage, W. A. Henry, B. Agr 164
        - Silo building and filling, L. H. Adams 165
        - Varieties of corn, changes in the silo, and feeding rations, F. G. Short 165

Abstracts of publications of the United States Department of Agriculture, issued in 1889, Part II 168

- *Division of Botany* 168
    - Bulletin No. 8, February, 1889 168
        - A record of some of the work of the Division, G. Vasey and B. T. Galloway 168
            - Grass experiment stations 168
            - Notes on grasses 168
            - The genus *Panicum* in the United States 168
            - Some diseases of plants 168
- *Section of Vegetable Pathology* 169
    - Bulletin No. 9 169
        - Peach yellows, E. F. Smith 169
    - Quarterly bulletin, March, 1889—Journal of Mycology, Vol. V, No. 1 169
    - Quarterly bulletin, June, 1889—Journal of Mycology, Vol. V, No. 2 169
    - Quarterly bulletin, September, 1889—Journal of Mycology, Vol. V, No. 3 169
    - Quarterly bulletin, December, 1889—Journal of Mycology, Vol. V, No. 4 170
    - Bulletin No. 10 170
        - Report on experiments made in 1888, in the treatment of downy mildew and black rot of the grape-vine 170
    - Circular No. 7, August, 1889 170
        - Grape-vine diseases, B. T. Galloway 170
    - Circular No. 8, September, 1889 170
        - Experiments in the treatment of pear-leaf blight and apple powdery mildew, B. T. Galloway 170

List of publications of the United States Department of Agriculture, November 15, 1889, to January 15, 1890 171

List of station bulletins of 1889, received by the Office of Experiment Stations from November 15, 1889, to January 15, 1890 172

EXPERIMENT STATION RECORD.

Vol. 1. **JANUARY, 1890.** **No. 3.**

EDITORIAL NOTES.

The following is a brief summary of some statistics of the stations collated for the Annual Report of this Office for 1889.

Experiment stations have been in operation during 1889 under the act of Congress approved March 2, 1887, in all the States except Montana, North Dakota, and Washington. In several States the United States grant is divided, so that forty-three stations in thirty-nine States are receiving money from the United States Treasury. In each of the States of Connecticut, Massachusetts, New Jersey, and New York a separate station is maintained entirely or in part by State funds, and in Louisiana a station for sugar experiments is maintained mainly by funds contributed by sugar planters. In many States branch stations or substations have been established. If branch stations or substations be excluded, the number of stations in the United States is forty-six; if they be included, it is sixty-three. These stations with this Office expend in all about $725,000 per annum, of which $600,000 is appropriated from the National Treasury and $125,000 is received from State governments and other sources.

The working staffs of the stations may be classified as follows: Directors and vice-directors, 63; chemists, 106; agriculturists, 73; horticulturists, 40; botanists, 30; entomologists, 29; veterinarians, 19; meteorologists, 10; biologists, 5; viticulturists, 5; physicists, 3; geologists, 3; mycologists, 2; irrigation engineer, 1; in charge of substations, 14; secretaries and treasurers, 13; clerks, 16; miscellaneous, 17; giving a total of 449. Subtracting the number of officers who are entered in two classes, we have 402 as the total number of persons engaged in the work of the stations and of this Office.

Some idea of the distribution of the work of research among the stations may be gained from the following approximate data, collated chiefly from the station publications for 1888 and 1889. Twenty-seven stations are studying problems relating to meteorology and climatic conditions. Thirty-one are studying the soil, by investigations of its geology, physics, or chemistry; experiments in tillage, drainage, or irrigation; soil tests with fertilizers or other experimental inquiries. Thirty-five are making analyses of commercial and home-made fertilizers or are conducting field experiments with fertilizers. Thirty-nine are studying the more important crops with reference to methods of culture, manuring, and rotation; varieties adapted to different localities and purposes; and chemical composition and nutritive value. Twenty-five stations are investigating the composition of feeding stuffs and in some instances making digestion experiments. Seventeen are dealing with questions relating to silos and silage. Twenty-four are conducting feeding experiments for milk, beef, mutton, or pork, or are studying different methods of feeding. Eighteen are investigating subjects relating to dairying, including the chemistry of milk, bacteria of milk, creaming, butter making, and the construction and management of creameries. At least thirty-three stations are studying methods of chemical analysis. Botanical studies occupy more or less of the attention of thirty-three stations; these include investigations in systematic and physiological botany, mycology with especial reference to the diseases of plants, the testing of seeds with reference to their vitality and purity, and classification of weeds and methods for their eradication. Thirty-five work to a greater or less extent in horticulture, testing varieties of vegetables and fruits and making studies in varietal improvement and synonymy. Nine have begun operations in forestry. Twenty-five investigate injurious insects with a view to their prevention or destruction. Fifteen give attention to veterinary science. At least four are experimenting in apiculture and three in aviculture. Sugar making is experimented with at six stations, but the Louisiana Sugar Experiment Station does far more in this direction than any other.

During the calendar year 1889 the stations have published forty-five annual reports and two hundred and thirty-seven bulletins.

Changes in the personnel of the staffs during the year have been numerous. Only those in the directorship can be mentioned here. Florida has elected J. P. De Pass; in Michigan, Oscar Clute has succeeded Edwin Willits, who resigned to become Assistant Secretary of Agriculture; in Minnesota, N. W. McLain has succeeded Edward D. Porter; in Missouri, Edward D. Porter has succeeded J. W. Sanborn; in Nebraska, L. E. Hicks has succeeded C. E. Bessey; the New Jersey Stations have lost their director, George H. Cook, by death. His place is temporarily filled by Merrill E. Gates, president of Rutgers College, with which the Stations are connected; E. M. Shelton, of the Kansas Station, resigned his position to accept one in Australia, and no successor has been appointed; George T. Fairchild, president of the Kansas State Agriculture College, with which the Station is connected, has executive charge of the Station, and I. D. Graham, secretary of the Station, has charge of the correspondence.

By act of the legislature, the Experiment Station of the University of Georgia was removed from Athens to the vicinity of Griffin (Experiment P. O.), Ga., where it is in operation under the title of the Georgia Experiment Station, with R. J. Redding as director. The chemical work is done by special contract at the University of Georgia, but if the present plans are carried out will be done at Griffin as soon as laboratories can be prepared. The connection of the Station with the University, the institution which received the benefits of the land-grant act of 1862, is constructively preserved by allowing that institution a minority representation in the governing board.

In Arizona, New Mexico, and Utah, stations have been partially organized and steps taken to obtain appropriations from the United States Government for their maintenance. These Stations are located at Tucson, Ariz.; Las Cruces, N. Mex.; and Logan City, Utah. Their directors are, in Arizona, S. M. Franklin; in New Mexico, Hiram Hadley, president of the Agricultural College, with which the Station is connected; and in Utah, J. W. Sanborn.

ABSTRACTS OF BULLETINS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES FROM JANUARY TO JUNE, 1889.

PART III.

NEBRASKA.

Agricultural Experiment Station of Nebraska.

Department of the Industrial College of the University of Nebraska.
Location, Lincoln. Director, Lewis E. Hicks, Ph. D.

BULLETIN No. 5, JANUARY, 1889.

On certain injurious insects of the year 1888, L. Bruner (pp. 1–38).—Since his appointment, April 1, 1888, the entomologist of this Station has been chiefly engaged in correspondence with fruit growers and farmers, in making collections of injurious and beneficial insects, and in preparing a synoptical treatise of the *Orthoptera* of the State. As this treatise will be much more extensive than was at first anticipated, its publication will be somewhat delayed. This bulletin consists for the most part of compiled accounts (with incidental references to the author's own observations and experience) of the box-elder plant-louse (*Chaitophorus negundinis*, Thos.), green-striped maple worm (*Anisota rubicunda*, Fabr.), large willow saw-fly (*Cimbex americana*, Leach), apple-tree flea beetle (*Graptodera foliacea*, Lec.), apple-twig borer (*Amphicerus bicaudatus*, Say), corn-root worm (*Diabrotica longicornis*, Say), army-worm (*Leucania unipuncta*, Haw.), cut-worms (only insects of genus *Agrotis* are here described), and the box-elder bug (*Leptocoris trivittatus*, Say).

BULLETIN No. 6, MARCH, 1889.

Report of progress, including a history of the fields and description of the animals available for experimentation, H. H. Wing, B. Agr. (pp. 1–29).—This is an account of the work of the agricultural department of the Station from July 1, 1887, to June 30, 1888, which has been almost wholly preparatory. In June, 1888, Professor Wing resigned to accept the position of deputy director of the Cornell University Station. The Station farm has been in possession of the Industrial College of the University of Nebraska for about fifteen years. Since 1884 records of the farming operations have been kept with some degree of accuracy, and are given in this article under the title "Details of the Farm."

Experiments under way.—Work was begun with an appropriation from University funds made by the board of regents July 1, 1887. An experiment in subterranean irrigation, conducted on two plats of one-fortieth of an acre each, is briefly described. Soil thermometers and other meteorological apparatus have been put in place and a lysimeter built. Arrangements have been made for a lysimeter with an artificial water-table, to make the movements of the water similar to those in natural soil. A diagram shows the Station garden divided into plats on which grasses, clovers, forage plants, garden vegetables, grains, potatoes, and corn have been planted.

Details of the farm.—This includes a diagram and accounts of the subdivisions of the University farm, with notes on the crops grown in different fields, from 1884 to 1888, and on the orchards and groves.

Live stock.—Pedigrees and descriptions of four bulls and seventeen cows and heifers of the Station herd, a tabular statement of observations during the past three years upon the period of gestation of cows of different breeds and the weight of their calves at birth, and an account of observations on the persistency of color in swine.

Buildings.—These are a square frame building 40 by 40 feet, a one-story cottage, two barns, a wagon house, corn crib, and piggery. A new piggery is described in detail with diagrams.

FIELD EXPERIMENTS AND OBSERVATIONS FOR THE YEAR 1888, J. G. SMITH, B. S. (pp. 31–84).—With reference to what the Nebraska Station must do, it is remarked that—

> Nebraska is one vast farm. In exchange for the products of the manufactory, for coal and iron and the fruits of the loom, she offers food supplies and raw material. In the older States of the East and South, where the land has been cultivated for more than a hundred years and methods of agriculture have become established, it is no longer an unanswered query whether this or that cereal, vegetable, or forage plant can be successfully grown. But in the newer States of the West, States which have been but recently reclaimed from the "Great American Desert," the questions continually arise: What will do well with us? Can we profitably plant the same crops that we planted before we "came West?" Will Eastern grasses and clovers provide us with hay, or must we depend on the wild grasses for our supply? Are oats and corn the only *sure* crops? What vegetables can we plant in our own gardens and what must we leave for our neighbors to furnish? These and many kindred questions are continually arising, and these are the questions which the Experiment Station must seek first to answer.

Grasses, clovers, and other forage plants (pp. 32–46).—Thirty-six plats were sown with grasses. A list of these is given, with notes on each variety.

> The grasses which seem to merit trial by Nebraska farmers are the following, commencing with the earliest: First, *hay grasses*—hard fescue, tall fescue, tall oat grass, wild wheat grass, Johnson's grass, rescue grass, the Muehlenbergs, grama. Second, *pasture grasses*—sheep's fescue, meadow foxtail, English bluegrass, red fescue, redtop, perennial rye, grama. All the experiments showed the extreme fertility of Nebraska soil and the adaptability of the great grass family to it.

Experiments at the Station and by farmers in the State are reported to show "most emphatically" that other grasses besides native ones can be depended on for hay and forage.

> They not only thrive here, but they can be made a very profitable crop. * * * Tame hay is always salable. The current prices are more uniform than with corn. Tame grasses will thrive and ought to be thoroughly tried.

Twenty-six plats were sown with forage plants, mostly clovers, alfalfa, vetches, peas, lupines, and other leguminosæ, but included millo maize, Kaffir corn, and several kinds of millet. Of the leguminosæ tried this season, the best for hay and pasture were—

> Alfalfa, red clover, cow-peas, hairy vetches, spring vetches, alsike, sweet clover, and Japan clover. Those of less value, but which might still be profitably experimented with, are spurrey, serradella, sanfoin, white clover, and burr clover. The lupines are not worth planting. It is a fact of some importance that the staple pasture plants (red clover, cow-peas, and alfalfa) of the East, South, and West all do well here. Which of them is *the* best must be determined by future observations. Pearl millet (*Penniscetum spicatum*, Benth.) promises to be quite a valuable fodder plant for Nebraska. Common millet makes a very rich hay when cut in proper season, but if the seed is allowed to ripen there is some danger in feeding it to stock. Millet is a crop that we can highly recommend to Nebraska farmers.

Corn (pp. 46–51).—Here are given the results of a single season's tests of twenty-two varieties of field corn, twelve of sweet-corn, and eleven of pop-corn, with descriptive notes on some of the varieties.

> The following varieties of corn gave the most satisfactory results, commencing with the best: Riley's Favorite, Snow-flake, Golden Beauty, Mammoth Cuban, Profit, Early California, White Giant Normandy, and Hickory King, among the dent corns; Thorough-bred White Flint and Mandan Indian, among the flints.

Oats (p. 52).—Notes on nineteen varieties of oats.

Wheat (pp. 52, 53).—Nine varieties of wheat were sown, but, owing to too thick sowing, rust, and dry weather, failed to ripen grain.

Potatoes (pp. 53–57).—One hundred and seventy-six varieties were planted in rows 33 feet long, with hills 1 foot apart. A single eye was put in each hill, and only one variety was put in each row. The record of observations for each variety is given in tabular form.

Peas (pp. 57, 58).—Here is given a tabular record of one season's tests of twenty-two varieties of peas. In these tests the best early peas were Cleveland's Alaska, Maud S., and Cleveland's Rural New Yorker. The best continuous bearer was the Dwarf Sugar. Vick's King of the Dwarfs was the best dwarf pea tried, being a very good continuous bearer. Carter's Premium Gem, American Wonder, Culverwell's Telegraph, Rural New Yorker, Quality, and Pride of the Market were good bearers, intermediate in season.

Cucumbers (pp. 58, 59).—Notes are given on eleven varieties.

> The Boston Pickle, Early Forcing, Early Green Cluster, and Early Russian are small and are suitable for pickling. The Perfect White Spined, Improved White Spined, Nichol's Medium Green, and White Dutch are large, suitable either for the table or pickling. The London Long Green, New Giant Pera, and Extra Long Green Turkey are extra large for table use.

Tomatoes (pp. 59–61).—Tests of fifteen varieties are reported. The results are briefly summarized as follows:

Earliest, Ely's King of the Earlies; best early, Dwarf Champion; early prolific, Ferry's Optimus, Large Round Yellow; good late, Mayflower, Queen, Acme, Trophy; best late, Mikado.

Peppers (pp. 61, 62).—Tests of seven varieties are reported.

Beets (p. 62).—Tests of fourteen varieties are reported. The largest yields were with Vilmorin's Sugar, Red Globe Mangel, and Early Flat Bassans.

Tobacco (pp. 62, 63).—Of the three kinds tested this season, Wilson's Prolific gave the best results.

Onions (p. 63).—Tests of ten varieties are reported. The largest yields were with Red Bassans, Danver's Yellow Globe, and Marzajola.

Carrots (p. 63).—Tests of six varieties are reported. Long Cassaby and Long White Belgian Great Top gave largest yields.

Miscellaneous plants (p. 64).—Under this head tests of a few varieties of parsley, cotton, egg-plants, and other vegetables are reported.

Observations on soil temperatures (pp. 65–79).—This is a tabular record from May to November, 1888, inclusive, of observations with 7 of Green's soil thermometers at depths of from 1 to 36 inches.

Rain-gauges (pp. 80–84).—Six rain-gauges were placed in different parts of the farm, on high and low ground, in open fields and in woods. The observations, recorded in tables, were made from July 5 to November 16, 1888.

METEOROLOGICAL REPORT FOR 1888, D. B. BRACE, PH. D., AND F. F. ALMY (pp. 85–98).—This is a tabulated record for each month of 1888. The observations included temperature, humidity, precipitation, and direction and velocity of wind.

BULLETINS Nos. 7, 8, 9, 10, JUNE, 1889.

ORIGINAL INVESTIGATIONS OF CATTLE DISEASES IN NEBRASKA, 1886–89, F. S. BILLINGS (pp. 267), (illustrated).

Southern cattle-plague and yellow fever (pp. 3–162). *Part I: Nomenclature; definition; geographical distribution; history* (pp. 3–21).—The author proposes the name "Southern cattle-plague of the United States" in place of "murrain," "splenic fever," "Texas fever," "Southern fever," or "Spanish fever," as this disease has been variously denominated. The disease is defined as an "extra-organismal-infectious-septicæmia." It is asserted that so far as known this cattle-plague is peculiarly an American disease which originates in those parts of our Southern States bordering upon the Gulf of Mexico and the Southern Atlantic Ocean. Though it is not positively known to exist in Europe, Asia, or Africa, the author is inclined to believe that this plague, or a near relative, has been described by Prof. S. Rivolta as existing in Italy. It occurs in the United States in the same latitudes, and under almost, if not quite, the same climatic and telluric conditions as does the yellow fever in man, to which in many ways it bears a close resemblance. The history of the disease is given for the most part by means of extracts from the reports of the United States Department of Agriculture.

Part II: Etiology (pp. 22–126).—Under this head the author gives at considerable length his views of the causes of the disease, especially in connection with observations made during outbreaks at Tekamah and Roca, Nebraska. In his opinion the disease is spread among Northern cattle by the pollution of trails and pastures with the excreta of diseased Southern cattle, principally from Texas.

The period of incubation in the Southern cattle-plague is given as "certainly under fifteen days." From ten instances in which the dates are given, 55 to 58 days is found to be the average time between the arrival of Texas cattle and the outbreak of disease among Northern stock.

The author claims to have found the germ of the Southern cattle-plague in the blood, gall, urine, liver, spleen, and kidneys of every diseased animal on which he made an autopsy. The germ was cultivated in an absolutely pure form in artificial media. The same germ was found in the tissues and organs of gophers, or ground-squirrels, inoculated with such cultivations, as well as in the tissues of cattle inoculated with pure cultures. It is described as ovoid in form (with a longitudinal diameter about twice that of the transverse), motile in culture media, and in length about one-sixth the transverse diameter of a red blood cell.

A close resemblance between the germ of the Southern cattle-plague and that of yellow fever in man is asserted by the author after an examination of tissues from several cases of yellow fever.

Part III: Nature of the Southern cattle-plague and yellow fever (pp. 127–162).—The similarity of these two diseases in their local origin and lesions and in the morphology of their micro-organismal causes is dwelt upon. For the prevention of the Southern cattle-plague the author advises that Southern cattle should not be allowed to be imported into or transported over a Northern State between March and November of each year. As this is the season when it is most profitable to feed these cattle, they may be admitted by requiring that Southern cattle be quarantined at some given point outside of the most northern limit where the disease exists, for a period, to be determined by experiment, which will insure their freedom from all disease-producing elements. Thirty days are thought to be a sufficient period for this quarantine. The quarantine station should be maintained by the National Government, and might also serve as a place for research. In permanently infected regions the author is quite sure that the disease can be prevented by inoculation.

The corn stalk disease in cattle (pp. 165–210).—Various theories concerning the origin of this disease are discussed, and the author's own investigations are given in considerable detail and compared with those of Professor Burrill, of the University of Illinois, on the cause of an obscure disease in corn. The conclusion is reached that the disease both in the corn stalk and in the animals which have fed on them is caused by "a micro-organism belonging to the class of ovoid-belted germs, to which variety of diseases also belong the swine-plague, Southern cattle-plague, wild seuche, hen cholera, and yellow fever in man." Methods of prevention based on this theory are also given. It should be remembered, however, that veterinarians generally have been inclined to attribute the disease to the mechanical action of the corn stalks on the alimentary canal. Further investigations are needed to settle this matter definitely.

The so-called hydrophobia in cattle (pp. 213–244).—While unable to define this disease, the author states that he has succeeded in cultivating "one germ from several outbreaks, and produced apparently the same disease by inoculating healthy animals with pure cultures obtained from the cattle (though not *in* cattle)," and has "again derived pure cultures from each animal and found the same micro-organisms in the tissues of these animals."

This germ is described as belted, twice as long as the germ of Southern cattle-plague and much narrower. It is navicular in shape, the pole ends being decidedly pointed and not round, but longer than wide. The uncolored substance occupies two-thirds of the body when the germ seems to have arrived at full development. On agar-agar it grows as a yellowish gray (dirty yellow), dryish, non-lustrous coating, which as it becomes aged is very friable. It does not fluidify gelatine. It was found very difficult to keep the organisms alive in artificial media, and then only for a few generations.

Investigations of outbreaks of this disease at Crete and Dorchester, Nebraska, are reported, including autopsies of diseased animals. The symptoms were found to correspond very nearly with those given by standard German authors as the indications of rabies in cattle, and the disease seems in some way to be connected with the presence of dogs which are asserted to be "mad." As a preventive measure the author recommends a strict dog license system, with a relatively high fee for females.

Contagious inflammation of the cornea in cattle (pp. 247–252).—This includes a description of the clinical phenomena and pathological lesions of this disease. In 1888 quite extensive outbreaks occurred in Nebraska, at Kearney and Gibbon, and near Lincoln. The disease first manifests itself by the discharge of a thin, clear, watery fluid from the conjunctival sac. The eyelids are partly closed and somewhat swollen, though the animal can open them easily enough when startled. The discharge rapidly increases in quantity, the conjunctiva becoming more and more swollen until, in severe cases, the engorgement of the vessels becomes so intense that its general color is almost a diffuse copper-red. In many severe cases the discharge becomes purulent. The animals do not show much rise in temperature. Their heads are depressed, the ears becoming pendulent. They refuse to eat, and rapidly emaciate, while the yield of milk lessens materially. At the end of a few days a yellowish spot is seen at or near the center of the eye and numerous delicate blood vessels taking their course from near this spot in a serpentine manner toward the sclerotic edges of the cornea. In many cases abscesses form, rupture, and discharge their contents.

Four colored drawings of the appearance of the eye at various stages are given.

The inference would be that from the severe inflammation the internal portions of the eye would become diseased. However, it is stated that aside from an oedematous condition of the iris the internal portions of the eye remain absolutely normal.

In stained sections of the diseased cornea a short, thin bacillus, with round ends, was observed, in which was either a clear center or a spore. Such an organism, the author says, may represent two organisms with a spore in each, or it may have a belted appearance.

Unsuccessful attempts to transmit this disease from diseased to healthy cattle are described.

The treatment advised is to keep the animals in a dark place, with cloths constantly hanging over their eyes kept wet with cold water. To prevent the extension of the malady complete isolation of the diseased from the healthy animals is recommended.

A singular disease in the external sexual organs of cows (pp. 253–255).—In August, 1888, cattle owners near Shickley, Nebraska, were alarmed by the appearance of a strange disease in a herd of two hundred and ninety-three cattle, two-thirds of which were cows and heifers. The disease was confined to the females of the herd. It commenced with tumefaction of the fleshy parts of the vulva; then small, hard nodules would develop, which at first were sharply circumscribed, but eventually coalesced. These nodules soon presented a broken surface which became red and granulous like proud flesh, until the whole vulva would become complicated in this way, with islands of intact skin in places. The malady did not seem to be necessarily fatal, and many cases of healing were reported. The healing, however, was accompanied by the extensive formation of cicatricial tissue, which led to a deforming retraction of the parts. In many cases the urethra became involved and completely closed, so that the animal died in intense agony from retention of the urine and the resulting renal and constitutional complications. The primary origin of the disease is buried in obscurity. Its outbreak in this herd was reported to be due to an old white cow which was said to have been similarly afflicted during four years.

It was subsequently discovered that a considerable outbreak had occurred near Kearney, Nebraska, in the winter of 1886. At that time steers were also affected, the disease attacking the tissues around the anus.

From a Mr. Rogers, of Gibbon, it was learned that the disease could be cured by treatment with pure carbolic acid. Saturate the diseased parts and some of the surrounding tissues with the acid. The severe sloughing which follows will result in a rapid recovery.

NEVADA.

Nevada Agricultural Experiment Station.

Department of Nevada State University.

Location, Reno. Director, S. A. Jones, Ph. D.

BULLETIN No. 5, JUNE, 1889.

METEOROLOGICAL REPORT FOR APRIL, MAY, AND JUNE, 1889, W. S. DEVOL, B. AGR. (pp. 1–14).—This contains notes on the "principal features of the weather for the quarter," under the topics atmospheric pressure, temperature of the air, dew-point and relative humidity, precipitation, wind, frost, and miscellaneous. Tabular records of the observations are also given.

NEW HAMPSHIRE.

New Hampshire Agricultural Experiment Station.

Department of New Hampshire College of Agriculture and the Mechanic Arts.

Location, Hanover. Director, G. H. Whitcher, B. S.

BULLETIN No. 5, MARCH, 1889.

FERTILIZERS AND FERTILIZING MATERIALS, G. H. WHITCHER, B. S. (pp. 3–18).—This is devoted to explanations of the nature, composition, and values of fertilizers and fertilizing materials. As a reason for the publication of the bulletin, it is stated that probably 80 per cent of all inquiries addressed to the station relate either to the use of fertilizers or to stock feeding.

BULLETIN No. 6, APRIL, 1889.

EXPERIMENTS WITH FERTILIZERS, G. H. WHITCHER, B. S. (pp. 3–32).—This contains explanations of the uses of fertilizers and accounts of experiments with various kinds.

Use of farm manures.—Under this head is given an account of an experiment on different methods of application of barn-yard manures. Six cords of manure were used on each of the 3 acres of land taken for this experiment. On one acre the manure was plowed under in the fall; on another it was spread on the surface in the fall, and on the third it was spread on the surface in the spring. The largest yield was with the second method and the smallest with the third.

Commercial fertilizers.—As regards these, the director states that—

> His own experience and that of farmers in various parts of the State have gone far towards demonstrating that more economical results may be obtained

by the purchase of crude fertilizing materials, waste products and chemicals than by the use of the many prepared goods that are bought. The results from the use of all fertilizers are more striking on the hill farms on soils of low *natural capacity* for production than they are on the river lands which produce larger natural crops.

Soil tests on the Station farm.—These were conducted on twenty-four plats during four years (1885–88) to find a "ration" suited to plants grown on the soil of the experiments. The fertilizing materials were selected so as to give the same number of dollars' worth ($8 per acre) on all the plats, regardless of composition. Materials containing nitrogen, phosphoric acid, and potash were used singly and in combination on corn, oats, and grass in a three years' rotation. Details are given in tabular form. In general the results indicate that potash led in effectiveness, with phosphoric acid second and nitrogen last. Similar and even more marked results have been obtained from experiments in this line in other parts of the State.

A part of the experiment is devoted to a comparison of nitrogen in the different forms of nitric acid, ammonia, and organic nitrogen in nitrate of soda, sulphate of ammonia, and dried blood. "There seems to be very little choice between the three forms of nitrogen used, but it does not appear in this case that nitrogen increased the crop."

Farm manures vs. artificial fertilizers.—This tells of an experiment to obtain light upon the question, "Can chemical fertilizers compete with farm manures?" It was conducted on 2 acres of land adjoining that of the previously described experiment. On one acre farm manure was used and on the other a mixture of dissolved bone-black, muriate of potash, and sulphate of ammonia. In 1885 and 1886 corn was grown on both acres; in 1887, oats; and in 1888, grass. Tables show amounts and cost of fertilizers and amount and value of crops. Comparisons are made between the amounts of potash, phosphoric acid, and nitrogen supplied by the soil to crops on unmanured plats, applied in fertilizers and removed by crops. On the assumption that no nitrogen was taken from the air by the soil or by the plants, an assumption to which later research is opposed, there is still, according to these estimates, an excess of nitrogen in farm manures in comparison with the potash and phosphoric acid.

Effect of fertilizers on vegetation.—Though both of the acres mentioned above were seeded and treated in the same way, throughout the season there was an abundance of clover on the acre where commercial fertilizers were used and a marked absence of clover where the barn-yard manure was used. In another field where nothing but commercial fertilizers had been used for five years and where part of the field was dressed with a mixture unusually rich in potash, the same difference has been plainly observed for two years. The plat experiments show even more plainly that the amount of clover follows very closely the per cent of potash in the fertilizer. A table is given in which the per cent of nitrogen, phosphoric acid, and potash in the fertilizers and the relative per cent of herd's-grass, clover, and redtop in the hay are stated for each plat. The following illustrations are taken from this table:

Composition of fertilizer.			Relative amounts of hay.		
Nitrogen.	Phosphoric acid.	Potash.	Clover.	Herd's-grass.	Redtop.
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
3	12	2	0	20	80
0	9	20.5	55	40	5
—	2	8	35	60	5
—	–	50	40	55	5
0	0	0	0	15	85
2.5	5.75	25	35	60	5

These results are similar to those obtained in the well-known experiments of Lawes and Gilbert in England. The development of clover where mineral fertilizers, especially those containing potash, were used, coupled with the fact, which may be regarded as pretty well established, that leguminous plants obtain nitrogen from the air, makes the use of such fertilizers a very important matter in regions like this.

The bulletin also contains a number of formulas for mixtures of dissolved bone-black, muriate of potash, and sulphate of ammonia, which have been tested and found well adapted to soils in New Hampshire. It should, however, be remembered that the results of hundreds of experiments show that such formulas should be used with great caution, since the needs of particular soils vary greatly.

Practical conclusions.—The following are among the practical inferences drawn from the experiments reported in this bulletin:

(1) So far as results have been obtained we are justified in saying that chemicals rightly proportioned can be used as a complete substitute for farm-yard manure; that they will produce as great a value of crop, dollar for dollar, as manure; and that they improve the quality of the hay by increasing the clover, and, indirectly, the supply of available nitrogen.

(2) Farmers are advised to buy dissolved bone-black, containing 16 per cent of soluble phosphoric acid; muriate of potash, containing 50 per cent of actual potash; and sulphate of ammonia, containing 20 per cent of nitrogen; and from these crude materials to mix such combinations as are best suited to the soil and crops under cultivation.

(3) Every farmer can experiment for himself if he buys his *deficient plant* food in these separate substances for he is at liberty to mix them in any proportion that he pleases, and in time it would be possible for each farmer to supply those elements which the soil most needs, and to withhold those not specially required.

BULLETIN No. 7, MAY, 1889.

TEST OF DAIRY APPARATUS, G. H. WHITCHER, B. S. (pp. 3–16).—This contains an account of tests made at the Station during a farmers' institute, held January 8, 9, and 10, 1889, and conducted by a committee of three persons agreed upon by officers of the Granite State Dairymen's Association, State Board of Agriculture, and the Experiment Station. The apparatus, milk, and chemical and other work were furnished by the Station.

(1) *Comparative test of five different systems of setting milk for cream raising.*—The efficiency of each system was measured by the percentage of the fat in the milk which was recovered in the butter. A test was made with 150 pounds of milk set by each system, 75 pounds in the morning and 75 at night. Chemical analyses were made from samples of milk before setting, skim-milk, buttermilk, and butter for each system. The relative merits of the butter made by the different systems were also tested by a committee of experts. The bulletin contains a full account of the tests and of the systems tried and comparative statements of the results obtained.

(2) *Test of three churns.*—The details are reported in tabular form, and the results as given show " that there is practically no difference in the efficiency of these three churns," though they differ somewhat as regards ease of handling and cleaning.

(3) *Butter exhibit.*—Samples of butter from fourteen creameries and eleven private dairies were exhibited. An expert taster selected from each class the samples which were first, second, and third best. A description is given of the methods used in making the butters which received the awards, and the results of chemical analyses of fifteen samples of creamery butter and five of dairy butter are also stated, including the per cent of fat, water, casein, and salt, and the volatile fat acids. A comparison of the results of these analyses with the opinions of the expert taster indicates that something more than chemical analysis is required to determine the marketable qualities of butter.

NEW JERSEY.

New Jersey State and Agricultural College Experiment Stations.

Location, New Brunswick. Director, Merrill E. Gates, LL.D.

BULLETIN No. 52, MARCH 20, 1889.

THE WORST WEEDS OF NEW JERSEY, B. D. HALSTED, SC. D. (pp. 2–15).—This contains a plan for the investigation of the weeds of the State in co-operation with farmers, orchardists, nurserymen, floriculturists, and gardeners. The effort will be made to obtain a full list of the native and imported weeds, arrange them in the order of their harmfulness, study the peculiarities of each kind, and finally consider measures for their eradication. To assist in determining the comparative viciousness of weeds, a scale of twenty points has been constructed, with five grades under each point, making a total of one hundred as the maximum for the worst weed. The points and methods of grading may be briefly illustrated as follows:

(1) *Recognition of the seed.*—The seed of quack grass is distinguished with great difficulty and is therefore put in grade 5, while that of sorrel, being less difficult to distinguish, is put in grade 3.

(2) *Separation of the seed.*—The seed of dandelion being quite difficult to separate from desirable seed, is graded as 4, while that of purslane can be easily separated and is hence put in grade 1.

(3) *Recognition of the weed plant.*—Weed plants vary greatly, especially as to the characteristics which distinguish them from useful plants. Canada thistle, which is graded 4, is much less easily recognized than the dandelion, which is put in grade 1.

(4) *Prevalence.*—The scarcity or abundance of a particular variety of weed in a given locality largely determines the amount of damage which it does. In this respect, for example, Canada thistle is a worse weed in some localities than dandelion.

The other points in the scale are as follows:

(5) *Ability to rob the soil;* (6) *Seed-producing capacity;* (7) *Disseminating power;* (8) *Vitality of the seed;* (9) *Longevity of the plant;* (10) *Root and stem propagation;* (11) *Poisonous or other obnoxious qualities;* (12) *Forage value;* (13) *Resistance to methods of eradication;* (14) *Aggressiveness;* (15) *Harboring injurious fungi;* (16) *Harboring injurious insects;* (17) *Relation to soil;* (18) *Relation to climate;* (19 and 20) *Miscellaneous.*

The result of marking weeds according to this scale is illustrated in a table for eight different kinds of weeds. Canada thistle rates 74 in badness, ox-eye daisy 64, quack grass 54, narrow plantain 43, sorrel 38, and toad-flax (butter and eggs) 31. This method of marking is, of course, subject to revision and must be varied considerably for different localities.

The bulletin also contains a set of questions with reference to weeds, addressed to farmers and gardeners for the purpose of securing information which may lead to the establishment of principles for cleaner culture in future and to legislation against weeds.

BULLETIN No. 53, MARCH 26, 1889.

PRICES OF NITROGEN, PHOSPHORIC ACID, AND POTASH, G. H. COOK, LL. D. (pp. 2, 3).—This contains the schedule of trade values adopted by several experiment stations for 1889 and explanations of the practical use of these values.

BULLETIN No. 54, MARCH 27, 1889.

POTASH AS A FERTILIZER, E. B. VOORHEES, M. A. (pp. 2–11).—"Field experiments with fertilizers have been an important feature of this Station's work since its establishment in 1880." The main object has been to test the wants of different soils in regard to nitrogen, phosphoric acid, and potash. The results, some of which have been very valuable, have been published in the annual reports of the Station. This bulletin is important as a summary of the results of co-operative work by the Station and farmers under its direction in different parts of the State during nine years. Its objects are "firstly, to summarize the results of the Station's experiments, to present the experience of individual farmers, and to give the conclusions reached by the Station in regard to the use of potash; and, secondly, to indicate lines of experiment with this material capable of being carried out by the farmers themselves." Five experiments here reported are essentially soil tests involving the use of nitrate of soda, superphosphate and muriate of potash, singly, two by two, and all three together. Plaster, kainit, and fine barn-yard manure were also used, and for sorghum other fertilizers and combinations were added.

Corn.—Experiments by Messrs. Thompson and J. Voorhees for five years on all parts of their farms confirm the conservative conclusions reached in 1882 and 1883, that while all the fertilizing elements are effective, potash is by far the most profitable for corn. The experience of Mr. Thompson also indicates that kainit is more economical than muriate of potash.

Sorghum.—The following is a summary of results of experiments on sod ground in different parts of the college farm from 1881 to 1885, inclusive, republished from the annual report of the Station for 1885: *Yield of sorghum.*—(1) Without exception, muriate of potash has increased the weight of the crop. (2) This increase has annually exceeded that caused by phosphoric acid and nitrogen, used singly and in combination, and, with one exception that caused by a combination of phosphoric acid and potash. (3) With two exceptions, this increase has exceeded that caused by nitrogen and potash, by nitrogen, phosphoric acid, and potash, and by 20 tons per acre of barnyard manure. *Yield of sugar.*—Without exception, muriate of potash has increased the total yield of sugar per acre, and this increase in every case exceeded combinations of nitrogen and phosphoric acid, or of nitrogen, phosphoric acid, and potash, and, with a single exception, combinations of phosphoric acid and potash.

The results secured from similar experiments on sorghum at Rio Grande, Cape May County, during 1885, 1886, and 1887, corroborate the above statements in nearly every particular, and admit of the conclusion that *potash is the element which exerts the most marked effect upon the yield of sorghum.*

Sweet potatoes.—An experiment with fertilizers on crops in a four years' rotation, begun in 1882 by Mr. A. P. Arnold, has shown the favorable effect of potash on sweet potatoes, as indicated by the crop of 1883, and its effect in improving the crop-producing power of the soil, as indicated by the second crop of sweet potatoes in 1887. The soil of this farm is a very sandy loam, easily tilled, responsive to fertilizers, and especially suitable for sweet potatoes, berries, and small fruits. "Commercial fertilizers are recognized as necessities and are used as freely as good management will warrant." At the close of the first rotation, the following conclusions were reached:

(1) Potash used alone greatly increased the profits. In this case the net value of increase was equal to 180 per cent on the cost of the muriate of potash used.

(2) Potash in combination with nitrogen and phosphoric acid, respectively, was also profitable, while the combination of nitrogen, phosphoric acid, and potash, though it required the largest investment, yielded the largest profit—namely, 110 per cent on the market value of the complete potato manure used.

In 1887 the improvement in the value of the sweet potato crop, due to the continued use of potash, varied from 8 to 107 per cent in the different plats. "In the cases where potash was excluded, the decrease in the value of the second potato crop was serious, ranging from 36 to 63 per cent." Muriate of potash caused an improvement of 35 per cent in the crop-producing power of the plat on which it was used, as well as a large increase in the net value of the crops produced, so that the increase in the crop-producing power of the land was gained without sacrifice of any kind.

General experience of New Jersey farmers in the use of potash.—Questions relating to the quantity, quality, and form of potash used and to the results obtained with this fertilizer were sent to a few farmers in each county of the State. Answers were received from twenty-three farmers, representing ten counties; of these, seventeen, representing nine counties, reported the profitable and continued use of either muriate of potash, kainit, or unleached wood ashes. Twelve farmers, representing eight counties, favored the use of muriate of potash, while five, having used both muriate and kainit, were satisfied that kainit gave the largest returns for the money invested. While these results are only to be accepted for the farms and crops represented, they indicate a general lack of potash in the soils of the State and show the importance of soil tests by the farmers themselves. The Station intends to perform experiments during the present season to further test the effect of potash as muriate and as kainit upon corn and potatoes. As kainit contains from 30 to 40 per cent of common salt it is very desirable to determine what proportion of its good effects may be due to that substance. In the present year, therefore, common salt will be used on one plat.

Directions are given for experiments by farmers who may desire to test the needs of their soils and crops without further aid from the Station. It is believed that a plan which includes the study of a single kind of plant food with simple directions will encourage those individual experiments by farmers which are so necessary an adjunct to experiment station work. When the method of work in studying rational fertilization is well understood "plats may be added for the study of the other elements—phosphoric acid and nitrogen."

BULLETIN No. 55, MARCH 28, 1889.

ENTOMOLOGICAL SUGGESTIONS AND INQUIRIES, J. B. SMITH (pp. 2, 3).—This explains to farmers how they can help the Station by "giving the results of their experience, by aiding in the experiments, and by giving opportunities for making them." Directions are given for preserving, packing, and sending specimens to the Station. It is stated to be the intention of the Station to study thoroughly each year the insects affecting some particular crop. "In 1888, cabbages received most attention; for 1889, cranberries have been selected." Cranberry growers are urged to assist in these investigations.

SPECIAL BULLETIN C, APRIL 8, 1889.

POLLEN AS AFFECTED BY RAIN, B. D. HALSTED, SC. D. (pp. 2–4).—This is a brief outline of proposed experiments to study the relation between wet weather at the time of the flowering of fruit-trees and plants and the setting and maturing of fruit. It is especially addressed to fruit growers, who are urged to co-operate with the Station in making tests along this line.

SPECIAL BULLETIN D, APRIL 9, 1889.

MEMORANDA ABOUT CRANBERRY INSECTS, J. B. SMITH (pp. 3–7).—This contains brief notes on the vine worm or fire worm (*Rhopobota* (*Anchylopera*) *vacciniana*, Pack.), glistening cranberry moth (*Teras oxycoccana*, Pack.), berry worm, or fruit worm (*Acrobasis vaccinii*, Riley), cranberry tip-worm (*Cecidomyia* sp.?), red-striped cranberry worm (*Tortricid* sp.?), and the cranberry span-worm (*Cymatophora pampinaria*, Gn.), with a request to cranberry growers to send to the Station information regarding these and other insects damaging the cranberry crop, which will be of use in the special investigation of these insects, to be made by the Station during 1889.

SPECIAL BULLETIN E, APRIL 13, 1889.

OYSTER INTERESTS OF NEW JERSEY, JULIUS NELSON, PH. D. (pp. 2–40).—This is a reprint of the report of the biologist of the Station, included in the annual report of the Station for 1888, a digest of which was published in Experiment Station Bulletin No. 2 of this Office.

NEW YORK.

Cornell University Agricultural Experiment Station.
Department of Cornell University.
Location, Ithaca. Director, Isaac P. Roberts, M. Agr.

BULLETIN No. 5, APRIL, 1889.

ON THE PRODUCTION OF LEAN MEAT IN MATURE ANIMALS, I. P. ROBERTS, M. AGR. (pp. 5–8).—The experiment reported in this article was undertaken to throw some light on the question whether in feeding pigs it is possible to increase either relatively or absolutely the amount of lean meat or muscle in mature animals. Two grade Yorkshire sows, three and four years old, respectively, and one the mother of the other, were used. Both were in very thin flesh and apparently in the same condition. The older one was slaughtered and the amount of fat and lean in the carcass assumed to represent the proportions in the other pig when feeding began. A ration of corn, cotton-seed meal, and wheat bran, with an average nutritive ratio of 1:5.2 was fed for one hundred and forty-three days, after which the pig was slaughtered. On the assumption above mentioned, "the tables show a marked increase of the nitrogenous matter over the fat and a considerable decrease of the water as a result of the feeding. The experiment was in every sense preliminary, and of course the data are insufficient to furnish positive proof as to the questions asked; still, all the indications are that a mature animal can readily be made to increase in muscle or lean flesh."

DOES HEATING MILK AFFECT THE QUANTITY OR QUALITY OF BUTTER? J. P. ROBERTS, M. AGR. (pp. 13–20).—

> It is generally conceded that for best results in butter making, where the milk is set in deep cans, the milk should be placed in the creamer as nearly as possible at the temperature at which it is drawn from the cow; there being a considerable loss of fat in skim-milk if the milk is allowed to cool to any extent before being set. Of late there has been considerable controversy as to whether it is advisable under any conditions to warm the milk before setting, and the limit of temperature beyond which it is not safe to go.

Three series of experiments were made to throw light upon this important point. Milk from Jersey and Holstein cows was set direct from the cow or cooled to 60°, or cooled and then heated to 93° or to 135°. The time of skimming varied from eleven to twenty-four hours after setting.

> We may conclude as a result of these investigations, first, that there is a loss of butter when the milk is allowed to cool much below the normal heat of the cow before being put in the creamer; second, that while there may not be any very great increase of butter when the milk is heated, there is no risk of injuring the quality of the butter by incorporating an excess of casein even when the milk is heated as high as 135°.

BULLETIN No. 6, JUNE, 1889.

ON THE DETERMINATION OF HYGROSCOPIC WATER IN AIR-DRIED FODDERS. W. P. CUTTER, B. S. (pp. 23–25).—Specimens of hay, bran, and cotton-seed meal were dried each in (1) an open watch-glass, (2) a tube in a current of dried air, and (3) a tube in a current of dry hydrogen at (*a*) 97° C. in a water bath, (*b*) 100° C. in an air bath, and (*c*) 110° C. in an air bath. One portion of each material was dried in a vacuum. There were thus thirty trials in all. The results of four determinations are tabulated. The conclusions are:

(1) Raising the temperature raises the percentage of loss.

(2) Loss at 100° in an air bath corresponds closely to loss in a vacuum.

(3) The effect of the temperature of 110° is greater in the determination on the hay than on the bran and cotton-seed meal. This seems to indicate either the presence of a greater percentage of easily volatilized constituents in the hay, or that the hay gives up its moisture with more difficulty.

Examinations of products in the current of air passed over hay implied that the latter loses more by volatilization and oxidation than the other materials.

Drying at 100° in a current of hydrogen appears, therefore, all things considered, to offer the least objection and the nearest approach to a correct determination of the hygroscopic moisture in fodder.

The determination of nitrogen by the azotometric treatment of the solution resulting from the Kjeldahl digestion, W. P. Cutter, B. S. (pp. 26, 27).—Experiments were made to test the value of the azotometric method, as recommended by Schoenherr, for determining the ammonia from the Kjeldahl digestion process. A modification of the Knop-Wagner azotometer was used. The averages of the results obtained by the azotometer when the solution was not neutralized before treatment with hypobromide were nearly identical with those by distillation in the ordinary way. The azotometric method has the advantage of not requiring so great purity of re-agents as the distillation method, but taking into account the time and labor, the practical value of the former method is doubtful.

Fodders and feeding stuffs, W. P. Cutter, B. S. (pp. 27, 28).—This includes a tabular record of analyses of fodder corn, wheat bran, cotton-seed meal, turnips, and cotton-seed hulls.

NORTH CAROLINA.

North Carolina Agricultural Experiment Station.

Location, Raleigh. Director, H. B. Battle, Ph. D.

BULLETIN No. 61½, FEBRUARY 12, 1889.

Fertilizer analyses (pp. 2–4).—This is a partial list of analyses of licensed commercial fertilizers for 1889 and includes reports on twenty-seven different brands. Mention is also made of advance in cost of raw material used for manufacturing fertilizers, of material for bags, and of freights by water.

Seed examination for planters (p. 4).—This Station is now equipped for an examination of seeds with reference to their purity and capacity to germinate, and will make seed tests for planters free of charge if the samples are properly taken and correctly described. A form is given for describing samples, with directions for taking them.

BULLETIN No. 62, FEBRUARY 28, 1889.

Fertilizer analyses and the fertilizer control for 1889, H. B. Battle, Ph. D. (pp. 86–99).—The objects of the fertilizer control as conducted by the Station under a State law are stated to be as follows:

> To protect the farmers of the State from fraudulent fertilizers by requiring every manufacturer doing business in the State to take out a license on each brand on sale by him; to exercise a general control of the trade by a system of inspecting all brands legally on sale in the State; and by chemical analysis to ascertain if their qualities are maintained at a guaranteed standard.

The bulletin contains a digest of the fertilizer laws now in force in North Carolina and a list and tabular record of analyses of seventy-five brands, with explanations of the technical terms used in the tables. Attention is called to the fact that the analysis of a fertilizer requires much time, skill, and patience. It is stated that an analysis of an ammoniated fertilizer, as made at the Station, requires three days and the combined work of four trained chemists, besides the labor of preparing the sample for analysis and the clerical work for calculating and recording their results. Of course a number of analyses are made at one time. After this work is completed it receives the careful consideration of the director. In all, then, a single sample passes through the hands of eight persons, each one carefully making a record of his work which is filed and preserved for future reference.

BULLETIN No. 62½, MARCH 27, 1889.

A reprint of Bulletin No. 62 of this Station.

BULLETIN No. 63, JUNE, 1889.

TESTS OF SEEDS, G. MCCARTHY, B. S. (pp. 103-111).—This article is preceded by the following summary:

> *Abstract of contents.*—(1) Introductory—Necessity of a standard of value for seeds—The English standard for grasses and clovers—Proposed American standard—Suggestions of helps toward examining seeds for impurities—Method of calculating the quantity of seeds in a gram and in an ounce—Lessons taught by these experiments. (2) Examination and tests of seeds. (3) Tabular résumé.

In the absence of an American standard of purity and vitality the English standard was used. [No reference is made to the standards in use in Germany, where the subject has received more attention than elsewhere.] This Station has undertaken the collection of data for American standards. The results of tests of forty-eight varieties of clover, grass, and other forage plants are given in tables accompanied with descriptive notes.

> The following deductions may be drawn from these experiments:
>
> (1) That grass and clover seeds deteriorate very rapidly with age, and generally are not worth sowing after they are two years old.
>
> (2) That aged and deteriorated seeds are often sold by local store-keepers.
>
> (3) That farmers should test samples before purchasing seeds, and purchase directly from some reliable seed grower, or from a local merchant who will guarantee the quality of his seeds.
>
> (4) That a trustworthy standard of value for seeds, with laws, if necessary, to enforce its observance, is very badly needed.

RUST ON WHEAT AND COTTON (p. 112).—The Station solicits specimens of affected plants in order to study this subject. A set of questions is given covering the main points which should be explained in a letter of advice accompanying the specimens.

DOES STABLE MANURE IN DRYING LOSE ANY OF ITS AMMONIA? F. B. DANCY, A. B. (pp. 112, 113).—This is an account of an experiment made with a view to getting light on the question of loss of ammonia from ordinary manure piles. A miniature manure heap was made with 100 grams of well-rotted horse-stable manure, which contained about 60 per cent of water. Through this a slow current of perfectly dry ammonia-free air was passed for three weeks, until the manure had become completely dry. It was so arranged that the current of air in passing through thoroughly permeated the mass. The amount of ammonia in the outcoming current was determined, and weighed 3.36 per cent of the whole amount of ammonia originally present. As the ammonia present contained only a small amount of the nitrogen of the manure, it would appear that manure slowly dried in the air loses only a very slight portion of its ammonia. Fresh unrotted manure, in which there would be more fermentation, would probably have shown a greater loss of ammonia.

ANALYSES OF COMMERCIAL FERTILIZERS AND PAMUNKEY MARL PHOSPHATE, H. B. BATTLE, PH. D. (pp. 113–115).—This contains a report on analyses of five different brands of commercial fertilizers. "Pamunkey marl phosphate" was also analyzed, though not coming under the requirements of the fertilizer law, because it is not a manipulated fertilizer. Though sold in the State at $10 per ton as having considerable fertilizing value, it was found to be about four-fifths sand and to contain so little of actually fertilizing ingredients (phosphoric acid and potash) as to make it "doubtful whether the value is sufficient to pay the freight alone."

OHIO.

Ohio Agricultural Experiment Station.

Location, Columbus. Director, Charles E. Thorne.

BULLETIN VOL. II, No. 1 (SECOND SERIES), MARCH, 1889.

ENTOMOLOGY, C. M. WEED, M. S. (pp. 3–19).—This contains, in Article I, an account of remedies for codling moth, canker-worm, apple-tree borer, plum curculio, snowy tree cricket, raspberry saw-fly, imported currant worm, imported currant borer, striped vine beetle, clover seed midge, clover root borer, and Colorado potato beetle; in Article II, notes on the common insecticides and their application; and in Article III, directions for collecting, preserving, and studying insects. The explanations are illustrated pictorially.

BULLETIN VOL. II, NO. 2 (SECOND SERIES), APRIL AND MAY, 1889.

COLIC OF HORSES, H. J. DETMERS, M. V. D. (pp. 21–69).—This is a treatise on colic of horses—causes, symptoms, diagnosis, prognosis, treatment, and prevention. The author believes that "The real predisposing cause of colic, or the real cause why horses suffer so much more frequently than other animals, must be found in the exceedingly frequent occurrence of aneurisms in the anterior mesenteric artery." The aneurisms are caused by small worms (*Sclerostomum equinum*, Rud., or *Strongylus armatus*). Professor Bollinger, of Munich, is referred to as having found worm aneurisms in 49 per cent of all horses examined, and in 90 to 94 per cent of all aged horses. Such aneurisms were found in twenty out of twenty-one horses examined at the Station, or in 95 per cent.

BULLETIN, VOL. II, NO. 3 (SECOND SERIES), JUNE, 1889.

SILOS AND SILAGE, J. F. HICKMAN, M. A. S. (pp. 73–88).

Historical.—In connection with a brief account of the first use of the silo in this country and abroad it is stated that—

> The extravagant claims at first made by silo enthusiasts led practical farmers and chemists alike to denounce the method as both impracticable and unscientific, but farmers have discovered improvements in the methods of producing, preserving, and feeding silage, while chemists have demonstrated wide differences in the chemical composition, and consequently in the nutritive values of different forms of silage, so that the silo, which at one time seemed to be losing ground, is to-day generally recognized as a very useful adjunct to the equipment of every dairy farm, and to many farms where dairying is not the chief pursuit.

Location, form, and size of silo.—If possible the silo should be under the same roof with the feeding place. In most dairy barns the cows are in stanchions in two long rows facing each other. In this case the most convenient place for the silo would be at the head or at one side or the other of this feeding room; or, if neither of these localities can be used, directly back of and inside or outside of the building. A portion of a root cellar in a bank barn might be conveniently partitioned off for a silo, or the floor of a root cellar under a haymow might be moved and the silo extended upward 8 or 10 feet above the barn floor. As to form, in the opinion of the author the most economical silo is one with its longest line from top to bottom, because less surface will be exposed while the silage is being fed. The size of the silo should be in proportion to the size of the herd to be fed from it. Whether the silo should be divided will depend upon the relation between the size and the number of cattle. For example, if twenty cows are fed from a silo 20 feet square it would be better to divide it, but if the herd is increased to forty and fed from the same silo a partition is not especially desirable. If two different crops, as fodder and clover, are fed from the same silo it is better to place each in a separate compartment.

Construction of a silo.—An account of the method used in constructing the Station silo in 1888 and an illustrated description of an outside wooden silo are given. Wooden silos are recommended. The plan of double boarding with tarred paper between has been wholly successful at the Station and is comparatively inexpensive. The importance of a solid and dry foundation and a strong framework is urged.

Silage crops.—Corn, it is thought, must be chiefly depended upon for silage. "For a large yield in tons we would use the Southern or silage varieties. The dents will give a moderate yield in tons, while the sweet-corn varieties will come in last." Planting in drills 3 feet apart, with the kernels about 6 inches apart in the row, will give as large yield as if the planting were thicker, the fodder will be of better quality, and with a rich soil considerable grain will be produced.

Filling the silo.—A very cheap and convenient sled can be made, which will answer all purposes, if the silo corn is not too far from the pit or silo. This sled can be made out of a couple of 2 by 10 or 2 by 12 planks, say 12 feet long. Four 2 by 4 cross-pieces, well mortised into the planks, and fastened with 20-penny nails, will finish the sled, except the trimming of the runners so that they will have a well-formed curve on the front end. Loose boards thrown upon this kind of a sled will enable one to haul very easily a ton of fodder at a load; and by placing the butts of the fodder corn all one way and putting a 3 by 3 scantling under the tops, the load can be unloaded when it arrives at the cutter by two hands taking each an end of the scantling and raising that side of the load until the fodder-corn is turned completely over.

In hauling fodder corn long distances, if a low-wheeled wagon is not at hand, the "temporary rig" described in Bulletin No. 19 of the Wisconsin Station and again in this article will be found useful. The silage should be cut before storing.

Feeding silage.—Though put in for dairy stock the silage was successfully fed to horses, calves, and hogs. The horses were given one feed of 20 pounds per day, instead of hay, during February and March. With this ration their appetite was sharpened and the spring coat of hair was glossy. "The skin was loose and the general appearance was that of horses running upon pasture."

To note the effects of feeding silage exclusively, twelve heifers were each fed from 40 to 50 pounds of silage per day in evening and morning feeds during eight weeks. The silage consumed cost only about one-half as much as hay would for the same period. "The heifers were not weighed during this experiment, but their appearance at its conclusion was such as to convince practical feeders that they had done better than they could have done with hay alone."

Comparison of varieties of silage corn.—In 1888 the following varieties were tested: Blount's Prolific, Sheep Tooth, Horse Tooth, Leaming, Clarage, Common Sweet, Southern White Ensilage. Although the soil was rich the largest yield was 19½ tons per acre, which is much less than many "silage enthusiasts" claim to be practically feasible.

The results of the writer's experience and observation are thus summarized:

(1) The silo should be built as near as possible to where the silage is to be fed.

(2) A solid foundation and well-constructed walls, whether of stone, concrete, brick, or lumber, are essential to success.

(3) Fodder corn, such as the B. & W. Blount's Prolific, Sheep Tooth, and other silage varieties, will yield much larger crops of fodder than any of our field corns or sweet corns.

(4) Corn for silage in Ohio should be planted from the 20th of May to the middle of June. The fertility of the soil should be a guide in the distribution of seed.

(5) Fodder corn should be cut when the corn begins to glaze, and when the stalks begin to dry near the ground.

(6) The silage may be cut from 1 to 4 inches long, and no inconvenience will follow in the feeding.

(7) The filling of the silo may be continuous, or it may be postponed for a day or two without serious injury.

(8) We advise weighting and otherwise securing well the top of the silo, making it as nearly air-tight as possible.

(9) Silage may be successfully, and oftentimes most conveniently, removed from the silo for feeding by mining.

He is thoroughly convinced that the silo is destined to become an important factor in farm economy, and is satisfied that dairymen generally may increase their incomes and decrease their outlays by the use of silage, and that many farmers may also use the silo with profit.

SILAGE VERSUS FIELD BEETS AS FOOD FOR MILK PRODUCTION, C. E. THORNE AND J. F. HICKMAN, M. A. S. (pp. 89–100).—"Twelve grade Shorthorns were selected, as nearly uniform as possible in breed, condition, and rate of milk production." This herd was divided into four lots (A, B, C, and D) of 3 cows each. The plan was to feed the cows on a uniform ration of 10 pounds of clover hay, 2 pounds of corn meal, and 4 pounds of wheat bran. In addition, lot A was to receive 40 pounds of corn silage daily per cow, and lot B 50 pounds of beets daily per cow, throughout the experiment; "while lots C and D were to have the same rations as A and B, but in alternate periods of two weeks each, C receiving the ration containing silage, while D received that containing beets, and *vice versa*." Details are given in five tables under the following headings: Feed required; percentage of fat in milk; average weight and dry matter consumed in food; production of milk and milk fat and gain or loss; weight and average daily consumption for entire test. The authors explain and insist that this experiment is only preliminary; that its purpose was to obtain experiences, and that for this purpose "it has been worth its cost." The results "point to two conclusions which they believe will be confirmed by further experiment."

(1) The dry matter of corn silage and of field beets is at least equal in value to the dry matter of the better grades of stock feed in ordinary use, when fed in properly adjusted rations.

(2) Corn silage is slightly superior to field beets as a flesh or fat producer, and beets are slightly better than corn silage for milk production.

OREGON.

Oregon Experiment Station.

Department of Oregon State Agricultural College.

Location, Corvallis. Director, E. Grimm, B. S.

BULLETIN No. 2, JANUARY, 1889.

HORTICULTURAL—PREPARATION AND NOTES ON PROPOSED WORK, E. R. LAKE, M. S. (pp. 15–27).—The work in this division of the station has thus far been preparatory.

That part of the grounds lying immediately around the college buildings has been thoroughly prepared for experiments with lawn grass seeds, mixtures of the same, and ornamental trees and shrubs. Other portions of the grounds have been underdrained and subsoiled with a view to their use in testing various kinds of vegetables and small fruits.

In the meantime seeds, trees, shrubs, and plants have been procured from widely different sources for the purpose of determining, if possible, the varieties best suited to this soil and climate.

A forcing-house 40 by 18 feet has been built and the testing of commercial seeds begun. Experiments with insecticides will be carried on in the college orchard. This now contains apple, pear, and plum trees, to which will be added prunes, cherries, and quinces. Small fruits will be set out, including currants, gooseberries, blackberries, raspberries, and strawberries. A number of varieties of grapes will also be planted, and nut-bearing and timber trees will be set out in limited numbers. A partial report of the tests of seeds thus far made is given, including twelve varieties of beans, thirteen of beets, twenty-seven of cabbages, thirteen of carrots, seven of cauliflowers, two of celery, seven of corn, nine of cucumbers, thirteen of lettuce, fourteen of melons, twelve of onions, eleven of pears, nineteen of radishes, five of ruta-bagas, five of spinach, fourteen of squashes, four of tobacco, twenty of tomatoes, fourteen of forage plants, and a number of varieties of less important vegetables.

PENNSYLVANIA.

The Pennsylvania State College Agricultural Experiment Station.

Department of the Pennsylvania State College.

Location, State College, Centre County. Director, H. P. Armsby, Ph. D.

BULLETIN No. 6, JANUARY, 1889.

TESTS OF VARIETIES OF WHEAT, OATS, BARLEY, POTATOES, AND FORAGE CROPS, W. H. CALDWELL, B. S. (pp. 3–16).—This is a report on tests of six varieties of wheat, six of oats, two of barley, seven of potatoes, and six of forage plants. Yields per acre, and in some cases data as to growth, date of ripening, weight, etc., are given in tabular form. Chemical analyses of the potatoes and some of the forage plants are also reported.

Wheat.—The varieties tested were: Sibley's New Golden, Fulcaster, Raub's Black Prolific, German Emperor, McGhee's White, Extra Early Oakley. The yields per acre of grain and straw in 1887 and 1888 are stated. German Emperor gave the best results both years, and Raub's Black Prolific stood next in yield in 1887, and Fulcaster in 1888. The Extra Early Oakley matured earliest of all in both seasons, but its yield was small.

Oats.—The varieties tested were White Victoria, Japan, Wide Awake, Henderson's Clydesdale, Welcome, Harris. The best results were obtained from Japan and Wide Awake.

Barley.—The varieties tested were Hulless or Nepaul, and Manshury. The Nepaul produced the heavier grain, but not as many bushels per acre as the Manshury. A letter from Dr. Grunow, of Mifflin, Wis., from whom the seed of the Manshury barley was first disseminated in this country, states that the barley was first introduced into Germany under the name of Mandschurei or Mandschurey, from the country where it was found (the northwestern part of the Chinese Empire).

Potatoes.—The varieties tested were Thorburn, Vanguard, College White, Monroe County Prize, Early Ohio, Early Beauty of Hebron, Dakota Red. None of the others equaled the College White, the variety usually grown on the college and Station farms.

Forage crops.—The varieties tested were prickly comfrey, Kaffir corn, Black Eye variety of cow-pea, teosinte, white mustard, Brazilian or flour corn. Only the first three seemed to merit further trial. Samples of the white mustard, Kaffir corn, and prickly comfrey, the last at three stages of development, were analyzed. The actual yields per acre, and the quantities of digestible nutrients computed by comparison of total yield, composition, and assumed coefficients of digestibility, are as follows:

Total produce and digestible nutrients.

[Pounds per acre.]

	Prickly comfrey.	Kaffir corn.	Cow-pea.
Total crop per acre	16,500	11,000	14,500
Digestible protein	221.0	119.4	280.9
Digestible fat	30.5	34.2	53.9
Digestible carbohydrates	658.4	941.0	937.0
Total digestible organic matter	909.9	1,094.6	1,271.8

BULLETIN No. 7, APRIL, 1889.

TEST OF VARIETIES OF CORN, W. H. CALDWELL, B. S. (pp. 3–14).—This is a record of experiments in 1888 to study the adaptability of some varieties of field corn to this section and to make observations upon the yield of the corn planted, at different stages of its growth.

They were performed on one-twentieth-acre plats of old sod land. No fertilizer was used. The varieties tested were: (1) Silage corn—Breck's Boston Market Ensilage, Blount's Prolific. (2) Dents—Chester County Mammoth, Golden Beauty, Golden Dent, Mammoth White Surprise, Pride of the North, Smedley, and White Giant Normandy. (3) Flints—Self-Husking, Thorburn's Golden Yellow, Tuscarora. "Samples for chemical analysis were taken at four different stages of growth: (1) When fully tasseled; (2) ears beginning to fill out; (3) kernels beginning to glaze; (4) fully ripe." Results are stated in tabular form, including yields per acre at the different stages of growth (as computed from yields of single rows), of corn as harvested and weighed, and of dry matter as indicated by analysis. This season's work implies:

> That for field crops such varieties as the Golden Beauty, Golden Dent, Smedley, and Pride of the North are the best adapted for this and the northern sections of the State. The Chester County Mammoth, Mammoth White Surprise, and White Giant Normandy may be used successfully in the southern portion as a field crop. With us they did not mature, and could only be used for fodder. The question of merit would then largely turn on the palatability of the stalks and their digestibility. The facilities of the Station would not allow the determination of the latter.

As the increase of total weight of dry matter should include all the nutritive materials and all water from period to period, the figures show that with these experiments, (1) while the percentage of water decreases as the plants advance in growth the absolute amount of water increases; (2) as the plants approached maturity there was a rapid increase of dry matter per acre, in many instances the amount of dry matter in mature stover alone being equal to or more than that of the total crop at any other period of the growth; (3) by allowing plants to mature there is considerably less water to be handled in proportion to the amount of actual food material than there would be if they were cut and used when the kernels began to glaze. At the same time the amount of valuable material (dry matter) is much greater.

The following points are given for "guidance in the culture of the corn crop:"

> Good seed, purchased of reliable dealers or judiciously selected from previous season's crop.
>
> Thorough plowing and pulverization of the ground.
>
> Not too close and heavy planting, as for success there is needed exposure to sunlight and air.
>
> Frequent cultivation and with as little manual labor as possible.
>
> Not too much haste in harvesting, as it is shown from the results of this year's experiments that if the crop is allowed to mature there will be a considerable gain in valuable material for feeding purposes. At the same time, the economy of harvesting will be greater, as there is relatively less water to handle.

Remarks on the foregoing experiments.—These are by the director of the Station. Corn is shown to be one of the most important crops in Pennsylvania. According to the census of 1880 it occupied almost as many acres and produced nearly two and one-half times as many bushels of grain as the wheat crop. With corn at 45 cents per bushel the 46,000,000 bushels produced in 1880 would be worth over $20,000,000, while the 19,500,000 bushels of wheat at 90 cents would be worth about $17,500,000. If we add the value of the stover and forage corn, it is probable that from $15,000,000 to $20,000,000 is a low estimate of the value of the annual corn crop of this State. The perfection of the process of ensiling has made it especially desirable that the Station should study the value of corn as a forage crop, both by comparing varieties and by observation of the yield and composition at different stages of maturity. "The results reached in regard to growth of the crop in its later stages are worth the careful attention of our farmers." Many other experiments have shown the rapid increase of dry matter per acre in later stages of the growth of corn. How far this increase can be utilized for forage is an important question and one upon which further data are desirable. "With our present knowledge, it seemed doubtful whether corn grown for silage should be allowed to stand much longer than until the kernels are beginning to glaze." To secure the largest yields of corn, a variety should be selected which could nearly or fully mature in this locality, and the crop should be permitted to grow until well advanced toward maturity. The results of experiments made at this Station on the digestibility of young corn fodder and stover show that while the former is more digestible, the difference is not very great. "The general conclusion to be drawn from our experiments then, as to the proper time of harvesting corn is that it should be allowed to stand as long as the climate of the locality and the purpose in view will permit, since it is continually increasing in value."

Analysis and valuation of fertilizers, W. Frear, Ph. D. (pp. 15–23).—This contains an account of kinds of fertilizers most used as sources of nitrogen, phosphoric acid, and potash, the text of the State law for fertilizer control, and valuations of fertilizers for 1889. In this State the fertilizer control is conducted by the State Board of Agriculture, who appoint inspectors to gather samples, which are submitted for analysis to the chemist of the Station, who is *ex officio* chemist of the board. The profits accruing from the analysis are devoted to furthering the work of research.

RHODE ISLAND.

Rhode Island State Agricultural Experiment Station.

Department of Rhode Island State Agricultural School.

Location, Kingston. Director, Charles O. Flagg, B. S.

BULLETIN No. 1, MARCH, 1889.

Organization, C. O. Flagg, B. S. (pp. 3–12).—This contains an account of the use made of the "land grant fund" in this State, the text of the act of Congress of March 2, 1887, for the benefit of the stations, and a brief history of the recent movement for the establishment of the State Agricultural School with which the Station is connected. The fact that the station was organized too late to secure the first year's appropriation under the act of Congress has caused delay in its beginning active operations. When this bulletin was written a farm had been bought with the aid of citizens of the town of Kingston, who contributed $2,000 for this purpose; a director *pro tempore* had been appointed and some preparatory work performed.

BULLETIN No. 2, JUNE, 1889.

THE STATION FARM, C. O. FLAGG, B. S. (pp. 15–28).—This contains a brief history of the farm from the settlement of Rhode Island to the present time; a description of the farm and buildings, with a map; and a short report on the geology of the farm, by E. F. Clark.

SOUTH CAROLINA.

South Carolina Agricultural Experiment Station.

Department of the University of South Carolina.

Location, Columbia. Director, John M. McBryde, Ph. D., LL. D.

BULLETIN No. 4 (NEW SERIES), JANUARY, 1889.

REPORT OF BOTANIST AND ENTOMOLOGIST, G. F. ATKINSON, PH. B. (pp. 45–91).—This was included in the annual report of the Station for 1888 (pp. 11–57), a digest of which was published in Experiment Station Bulletin No. 2. of this Office (pp. 175–179).

BULLETIN No. 5 (NEW SERIES), APRIL, 1889.

FIELD EXPERIMENTS WITH OATS AND WHEAT, J. M. MCBRYDE, PH. D. (pp. 3–21).—The objects of these experiments as stated were "to ascertain if possible (1) the requirements of the soils of our three experimental farms; (2) the requirements of our oat and wheat crops; and (3) the relative values of different kinds of nitrogenous and phosphatic manures." For the present the pecuniary results are regarded as of subordinate interest, but it is expected in the future to give them the attention they deserve. The following general remarks are worthy of attention:

> In any system of plat experimentation it is almost impossible to guard against error. The slighest difference in fertility, mechanical condition, or exposure of the plats; any irregularity in preparing the land, seeding, and harvesting the crop; any injuries by insects, birds, or storms; any mistakes in measuring and weighing, etc., will affect the results. Approximately trustworthy results can only be obtained by making duplicate tests. The great value of having duplicate sets of experiments to reveal the probable error from inequalities of soil is enforced by appropriate illustrations. It can not be too strongly insisted upon that it is unsafe and unwise to draw general or sweeping conclusions from the results of the tests of a single season. Such tests to have value must be continued through a series of years, for the results of the same tests may differ widely in different seasons.

The soils used in these experiments were typical ones, so that the results will interest farmers occupying similar lands. When purchased by the Station "all three farms [at Spartanburg, Darlington, and Columbia] were in wretched condition, worn out by years of improvident tillage." At Darlington the soil is an apparently sterile sand, on which are a few tufts of worthless grasses; the subsoil contains some clay. At Spartanburg there is some clay in the surface soil; the subsoil is clay.

Fertilizers on oats.—(1) *Special nitrogen experiments.*—(*a*) At Darlington: Six acres of the poorest land were divided into half-acre plats. Five kinds of fertilizing mixtures were used in duplicate tests on ten plats. The other two plats were unmanured. The full amounts of nitrogen, phosphoric acid, and potash (52 pounds, 19 pounds, and 38 pounds, respectively) estimated to be contained in the grain and straw of a crop of 45 bushels of oats per acre, were supplied in mixtures in the first three tests, while in the other two, one-half the quantity of nitrogen was furnished. Acid phosphate was used for phosphoric acid; muriate of potash and kainit for potash; cotton seed or cotton-seed meal for nitrogen, with some phosphoric acid and potash; and nitrate of soda for nitrogen alone. These materials thus furnished the phosphoric acid and potash of a crop of 45 bushels, and either all or half the nitrogen of the same crop, the nitrogen being supplied as nitric acid, organic nitrogen, or the two forms mixed. Details of the experiment are given in a table. The yield on the fertilized plats varied from 15.5 bushels to 26.5 bushels per acre, while on the unfertilized plats it averaged only 7.8 bushels. It appeared that 52 pounds of nitrogen per acre was an excessive amount for this soil, as one half the amount gave equally good results. Inorganic nitrogen gave better results than organic. (*b*) At Spartanburg: Five plats of 1 acre each were used and the tests were not duplicated. Four different mixtures of fertilizers were applied on four different plats and one plat was unmanured. The quantities of potash and phosphoric acid were not in all cases the same as in the Darlington experiments. The yield on the unfertilized plat was 8.4 bushels; on the fertilized plats it varied from 18.7 to 38.8 bushels. The results were decidedly favorable to inorganic nitrogen.

A comparison of four of the tests conducted on both farms indicates that the inorganic nitrogen gave nearly 100 per cent more increase of yield than the organic, and nearly 50 per cent more than both forms used together.

(2) *Special phosphoric acid experiments.*—The object of these experiments was to test the relative value of floats and Thomas scoria (basic) slag. (*a*) At Darlington: These were on two quarter-acre plats immediately adjoining those used in the above-mentioned experiments. The tests were not duplicated. One hundred pounds per acre of nitrate of soda were used with the phosphate. The yield was at the rate of 11.8 bushels per acre with the slag, and 9.75 bushels with

the floats. (*b*) At Spartanburg: Two and one-tenth acre plats were used. No nitrogen or potash was applied on either plat. The yield was at the rate of 20.3 bu. per acre with slag, and 18.75 bu. with floats. "The averages agree very closely with the results of the test at each farm. Slag shows a slight but steady superiority."

Fertilizers on wheat.—At the Spartanburg farm: These experiments were similar to those with oats mentioned above, but were more elaborate. Potash, phosphoric acid, and nitrogen were applied singly and in various combinations. On account of the poverty of the soil, and to test the effects of heavy manuring, amounts of the fertilizing ingredients estimated to be contained in about 50 bushels of grain per acre were applied. One-twentieth acre plats were used, and all the tests except two were duplicated. In spite of the poverty and poor condition of the soil the wheat on a number of the fertilized plats promised a large yield, but was seriously injured by rust just before harvest. The yields were all very small. On the unfertilized plats, and where single fertilizers were used, they averaged from 2 to 4 bushels per acre. There was a remarkably close agreement between the yields of the duplicate plats in each test, the average difference being only about one-half bushel of grain per acre. The following are among the results stated: (1) Nitrate of soda, muriate of potash, and acid phosphate applied singly produced no valuable result. (2) Nitrogen when used alone did no good, but in combination with phosphoric acid greatly improved the crop. (3) Phosphoric acid gave the most pronounced results.

Tests of varieties.—(1) *Oats.*—The varieties tested were: Red Rust-Proof, Georgia Grazing, Black Russian, Wide Awake, Badger Queen. Red Rust-Proof, a variety "highly esteemed in this section," gave the largest yield (35 bushels per acre). Georgia Grazing gave about the same total produce (120 pounds more straw and 80 pounds less grain). (2) *Wheat.*—Details of tests of eighteen varieties are given in tabular form. In order to test the effect of change of climate the seeds of Fultz, grown in Virginia and Illinois, were planted alongside of home-grown seed of the same variety, and seed of the Red May from Illinois were similarly compared with seed of the same sort from South Carolina. The yield in both cases was decidedly in favor of home-grown seed, a result "opposed to the opinion prevalent in some quarters that change of seed is desirable."

TENNESSEE.

Tennessee Agricultural Experiment Station.

Department of the University of Tennessee.

Location, Knoxville. Director, Charles W. Dabney, jr., Ph. D.

BULLETIN VOL. II. NO. 1, JANUARY, 1889.

NOTES ON FERTILIZERS AND FERTILIZING MATERIALS, W. E. STONE, PH. D. (pp. 3–24).—This contains analyses of fertilizing materials available to farmers of Tennessee, made with the purpose of pointing out their "characteristic and valuable features," in order that farmers may have a "basis for the more intelligent purchase and use of fertilizers." The samples analyzed were either sent to the Station by the Commissioner of Agriculture, or inquiring farmers, or furnished by dealers and manufacturers. The nature and uses of fertilizers are explained and the trade values for 1888 as adopted by the stations in Connecticut, New Jersey, and Pennsylvania stated. Results are given of the analyses of twenty-four kinds of commercial fertilizers, and of cotton-seed meal, cotton-hull ashes, plaster, marl, Thomas slag, tankage, animal manures, and tannery waste. According to the State act regarding the sale and inspection of commercial fertilizers, the full text of which is printed in the bulletin, all fertilizers sold within the State are to bear, plainly printed on the bag or package, a statement of their chemical composition. The State law also provides that the Commissioner of Agriculture shall prescribe a given per cent of ammonia, potash, and available phosphoric acid which the fertilizers must contain. At present the requirement is "that *acid phosphates or dissolved bones* (not ammoniated) must contain not less than 12 per cent of available phosphoric acid; and all *ammoniated superphosphates* must contain not less than 8 per cent of available phosphoric acid, 2 per cent of ammonia, and 1 per cent of potash; or if they contain less than 2 per cent of ammonia or less than 1 per cent of potash, they must then contain not less than 10 per cent of available phosphoric acid." Attention is called to the necessity of utilizing all available waste products. "It is not good economy to buy commercial fertilizers at $25 to $40 per ton and allow the manure piles of the farm to lie exposed to the leaching effect of every rain storm." The great and rapid growth of the cotton-seed oil industry and the utilization of the cotton-seed hulls and meal are used to illustrate the value which may be found in what are thought to be waste materials. A ton of cotton-seed meal has, at a low estimate, a trade value of $23.50, while a ton of cotton-hull ashes is worth $29.97. The chief value of the latter consists in their large percentage of potash.

These ashes are sent to the Northern States in large quantities, where farmers have been quick to recognize their value, and where they have become, to a certain extent, a substitute for Canadian wood ashes. As the result of rather limited inquiry, they have not been found on sale in this State. A manufacturing firm in West Tennessee, which produces them in large quantities, writes: "They are little, if any, used in the neighborhood of the mills where they are produced, but the market for this product is found in the New England States, where it finds a ready sale at good figures."

A point to be learned from a study of these facts is, that Tennessee farmers can not afford to let a pound of these materials go beyond the borders of the State. Why send this nitrogen, this phosphoric acid, and this potash away to the North and then purchase the same articles in fertilizers, the costly materials for which have been imported from the coasts or perhaps from beyond the seas?

BULLETIN VOL. II, NO. 2, APRIL, 1889.

DISEASES OF THE IRISH POTATO, F. L. SCRIBNER, B. S. (pp. 27–43).

Potato Rot (*Phytophthora infestans*) (pp. 27–37).—This contains an account of the life history of the fungus which causes potato rot, and advice regarding the treatment of the disease.

(1) The life history of the fungus, briefly stated, is as follows:

> The spores lighting upon the leaves of the potato germinate in drops of dew or rain, and the product of germination—the zoöspores—penetrate to the interior tissues of the plant, and after growing for a time through these tissues, the mycelium sends out, chiefly from the under surface of the leaves, slender fruiting branches whereon are produced a new crop of spores. These may carry the disease to the other plants in the field, or to other parts of the same plant; that is, they may serve to spread the disease in the tops, which we term blight, over the entire field, or by being washed into the ground they may reach the tubers and cause the rot. The fungus, once having gained entrance to the tubers, may or may not vegetate rapidly. Its presence, however, is soon made evident by a browning of the flesh underlying the skin and by a more or less extensive discoloration and depression of the latter. Under certain conditions the disease in the tubers may make no further progress throughout the winter, but the mycelium of the fungus remains alive and ready to renew its activity upon the first favoring circumstances. Such potatoes may often be found in the markets and are used for food every day, and it is too frequently the case that they are preserved for seed. Used for this latter purpose they will hardly fail to affect the new crop and bring about a new development of spores.

(2) Treatment:

> Select for planting a light, sandy loam or a soil which is well drained; plant only perfectly sound or disinfected seed; spray the tops with the Bordeaux mixture, or some preparation containing sulphate of copper; store in a cool, *dry* place and keep dry.

A new disease of the Irish potato (pp. 37–43).—The following abstract of this article was prepared by Mr. B. T. Galloway, chief of the Section of Vegetable Pathology of this Department, and has already been published in the Journal of Mycology, Sept., 1889.

> The new disease was discovered among the potatoes obtained from the University farm, and is described as causing the tuber to wither, then dry up and become hard. The skin is only partially discolored, but the surface is covered with small pimples, each surrounded by a depression. Sections through a diseased tuber revealed the fact that the flesh was apparently sound, but slightly wilted. The only discoloration of the flesh was immediately under the pimples; here the tissues were brown. The microscope showed that the brown areas were filled with numerous little worms of various sizes and development.
>
> "These little worms," says the writer, "were at once recognized as nematodes or thread-worms, and were evidently the cause of the disease."
>
> "How did these worms get into the potatoes? Probably from the soil in which they were grown, for it is known that many of the parasitic nematodes spend a certain period of their existence underground. It is very likely that they were first introduced into the University farm through planting infected seed. The potatoes planted were being saved for seed, and were these to be planted they would certainly carry the worms to the new crop and thus perpetuate the disease."
>
> Owing to the limited knowledge of the life history of the nematode the author says it is impossible to indicate any definite course of treatment.

TEXAS.

Texas Agricultural Experiment Station.

Department of Agricultural and Mechanical College of Texas.
Location, College Station. Director, F. A. Gulley, M. S.

BULLETIN No. 5, MARCH, 1889.

CREAMERIES FOR TEXAS, F. A. GULLEY, M. S., AND G. W. CURTIS, M. S. A. (pp. 3–24).—In view of the market demand for cheese and the cost of production the manufacture of cheese in Texas does not promise to be profitable and the Station "can not at present advise the extra cost of a cheese equipment in connection with the butter factory." The advantages of creameries are indicated briefly, and plans of organization and control and different systems of operating creameries are explained and discussed in some detail. The ordinary ways of setting milk or cream are unsatisfactory in the South, where cool springs and wells are rare. "The average temperature of well water in the Western States during summer is not above 50° or 55° F., while the average temperature of well water in this latitude will not fall below 60° or 65°, and more commonly approaches 70°." The ground in the South is too warm for creameries in subterranean earth or outdoor cellars, and the use of ice is out of the question. Centrifugal cream separators are recommended on the grounds that (1) the increased amount of butter, especially during the fall and winter, is sufficient to add materially to the profit of butter making; (2) "the sweet skim milk can be returned immediately to patrons for such use as desired;" (3) all necessity for cellars, cold water, or ice, except for churning and storage, is avoided; (4) there is a saving of labor in cleaning cans; (5) experience in the South has shown the advantage of separators for creameries and private dairies.

Detailed plans and specifications, with engraved illustrations, are given for a creamery with a capacity of 200 to 250 pounds of butter daily, similar to one that has been in operation since June, 1888, at the Agricultural and Mechanical College of Texas, but with such changes as a careful study of creameries in successful operation in other Southern States has shown to be advisable. The cost of such a creamery plant is from $2,500 to $3,000. Experience with creameries in the Gulf States has shown the necessity of certain modifications for the construction of such buildings in higher latitudes.

Some points in butter making.—Among these are the following: (1) Cows should have an abundance of good food and water. (2) Handle the cows quietly and carefully. (3) "Salt regularly, at least once a week; twice is better, or place lump salt where they can have access to it." (4) Milk regularly at a definite hour, and do not let the milk stand where it can absorb odors from the stable or barnyard. (5) When the centrifugal is used the best results will be obtained by separating at about 80° to 85° F. When the centrifugal is not used, if there is a cold spring or well water at hand, set the milk in deep cans, not over 6 or 7 inches in diameter, in water to a depth equal to the depth of the milk in the cans. When cold water can not be obtained, set the milk in shallow pans, 4 or 5 inches deep, in a well-made cellar. (6) Skimming should take place after eighteen to twenty-four hours in summer, and twenty-four to thirty-six hours in winter, approximately. (7) Churn when the cream is nicely acid, but not too sour; when the cream is thick add water. (8) The best temperature for churning in this latitude has been found to be 63° to 65° in summer and 69° to 70° in winter; *determine temperature with thermometer.* (9) All vessels should be scrupulously clean; "use hot water always," and if greasy, washing soda. (10) Use the best quality of dairy salt.

BULLETIN No. 6, JUNE, 1889.

FEEDING EXPERIMENTS. F. A. GULLEY, M. S. (pp. 3–39).—The experiment recorded in this article is the first of a series to continue several years. The four following questions were propounded:

> (1) Is it possible to conduct a feeding test that will be sufficiently accurate to be of value and at the same time make it an object lesson to the practical cattleman and give him information which he can make use of?
>
> (2) Is there any practicable method of sheltering range steers in winter feeding, and will it be profitable?
>
> (3) What feed stuffs that are obtainable in the State will give the best results in proportion to cost?
>
> (4) Can the common, unimproved Texas steer be fattened with profit?

The experiment began January 8 and continued through nine periods of ten days each. Forty-eight steers in eight lots of six each and eight old cows in one lot by themselves were used. The steers were native range cattle, three or four years old, and below the average of cattle in the State. These animals were selected because it was believed that if it could be shown that such cattle could be fed with profit it would have a relatively greater influence in encouraging the improvement of native cattle.

> We decided to use forty-eight steers, and to handle them in such a way that the number might be increased to five hundred or one thousand, if desired. We have used six steers to test each ration, knowing that men who feed on a large scale have little confidence in feeding tests made with but one or two animals. The variation in gain in weight of steers fed together on the same ration shows that popular prejudice against single animal tests is well founded.

While stockmen in Texas know that cattle will not gain in weight if exposed to cold, wet weather, it is generally believed that shelter is impracticable. Range steers when confined and closely tied up are apt not to thrive, and if left loose in the sheds, with their horns on, it is impracticable to keep a large number in a shed together. In this experiment, however, it was assumed that profitable feeding in Texas must include provision for shelter. A feeding shed 38 by 80 feet and 7 feet high was therefore constructed and the steers were dehorned. An additional pen was built outside in which six steers were kept without dehorning.

Dehorning.—This was performed successfully and with less apparent pain to the animals than might perhaps have been expected.

> While sawing off the horns of a full-grown steer may seem severe treatment and somewhat cruel, the fact that the operation requires very little skill and time, that it is safe, that it tames the animal to a surprising degree, and that a drove of the wildest cattle may run loose together in a building, like a flock of sheep, and that they will fatten faster after dehorning than before, leads us to believe that dehorning has solved the problem of making sheltering practicable, and that it will be adopted by the Texas cattle feeder.

The author believes it is shown from experiments with thousands of cattle in different parts of the country that dehorning may be performed as safely as castration, "while the pain suffered by the animal for but one or two minutes is not to be compared with injuries which cattle inflict on each other with their horns when massed together."

Feeding stuffs.—The eight old cows had a ration of silage, corn fodder, boiled cotton seed, and cotton-seed meal. Of the eight lots of steers, five had silage and hay. Besides these materials, lot 2 had cotton-seed meal; lot 3, boiled cotton seed; lot 4, raw cotton seed; and lot 5, cotton-seed meal and corn-and-cob meal. Of the others, lot 6 had cotton-seed hulls and cotton-seed meal; lot 7, silage, cotton-seed hulls, and cotton-seed meal; lot 8, hay and corn in the ear with the shuck; and lot 9, hay, corn in the ear with the shuck, and cotton-seed meal. Cotton seed was used in various forms and combinations because it is one of the cheapest feeding stuffs in Texas. Silage (corn for the most part) was largely used to show Texas stockmen, to whom it is "practically unknown," that it is an economical and desirable feeding material. The intention was to adopt the German standard for a ration, but on trial it was found that the cattle would not eat 3 pounds of digestible albuminoids and 16 pounds of carbohydrates and fat per 1,000 pounds of live weight, nor silage in the ratio of 1 to 5.

> In several years' experience in feeding Southern grown corn silage, we have found that cows and steers would never consume more than 35 to 40 pounds per day to 1,000 pounds live weight, while the average has not been above 25 pounds. The analysis of silage given by the chemist shows that Southern grown silage has a higher nutritive value than Northern grown silage, and our experience in feeding indicates that we get the same return in milk, butter, and beef from a less quantity.

Analyses of the feeding stuffs are reported (pp. 28–31) by H. H. Harrington, M. S., chemist of the Station, and his assistant, D. Adriance, and compared with the results of analyses at other stations.

The average amount of food consumed per day per head for each period; the live weights of the several animals in each lot at the beginning and end of the experiment, and at intervals during its continuance; the cost of the food consumed by each lot, and other data, are given in fourteen tables.

Profit in feeding.—At the present time the market value of the steer is determined principally by his fatness, though in certain markets objection is made to cattle fed on cotton seed. It is, however, beginning to be understood that more attention must be paid to the effects that different feeds have on the quality of the meat. The author of this article believes that " the time will come soon when the quality of the meat will determine its value as much as its fatness." In Texas, a native three-year-old steer weighing 800 pounds is estimated to be worth 1¾ cents gross, or $14. When fattened to a weight of 1,000 pounds, a small steer will be worth from $27.50 (2¾ cents) to $30 (3 cents) : in other words, a gain in value of from $13.50 to $16 is made by adding 200 pounds of fat.

Our experiment indicates that 200 pounds gain in weight may be made from $6 to $9 worth of silage, cotton seed, cotton-seed meal and cotton-seed hulls, leaving a good margin for profit after deducting cost of labor, wear and tear of plant and use of capital.

" The high value of cotton-seed hulls and cotton-seed meal for fattening cattle is shown by this experiment." The best result was obtained with a ration of boiled cotton seed. " Within the past two years, feeding plants with capacity for feeding from one thousand to three thousand head have been put into operation at the largest oil mills, and the business promises to enlarge until all the hulls will be consumed at the mills." It is thought that it would be better to dehorn the range cattle and feed them loose under sheds rather than to keep them in open yards, or tied up under sheds with their horns on. " In this experiment the steers kept outside and not dehorned made the lowest gain during nearly the entire time."

Conclusions.—The following are among the conclusions drawn from this experiment :

(1) The value and necessity of shelter are clearly shown. This result confirms the experience of other cattle feeders in the South.

(2) Dehorning is essential to make the sheltering of range cattle practicable.

(3) For coarse food use corn, sorghum and pea-vine silage, hay where it can be produced at low cost, and cotton-seed hulls near oil mills; for the more concentrated part of the ration use boiled cotton seed, cotton-seed meal, with perhaps some corn, rice meal or rice bran in sections where they can be procured cheaply. If the corn and sorghum grown for silage are planted thin and not harvested until nearly ripe, the silage will contain a considerable amount of grain, and, fed with cotton seed and cotton-seed meal, will produce a better quality of beef.

(4) The indication is that silage and boiled cotton seed make the cheapest and most rapidly fattening ration. Next follow in order cotton-seed meal and cotton-seed hulls; cotton-seed meal, cotton-seed hulls and silage; raw cotton seed and silage; corn and hay at the prices given.

Suggestions to feeders.—In fattening animals two things are essential: (1) Keep the animal comfortable; and (2) induce him to eat the largest amount of nutritious food.

Cattle fall off as rapidly during a cold, rainy spell in Texas, with the temperature at the freezing point or a little under, as they do in Dakota with the temperature below zero.

Range cattle need room in which to move about, and though they may be confined in a building, should be tied up by the head.

Wild cattle must be handled quietly.—If struck with a whip or disturbed in any way they will stop gaining weight for a time. Dehorning seems to have a marked effect in subduing wild steers. It is thought that the operation should be performed a short time before the cattle are shut up for feeding, "so that they may be fattened while their heads are somewhat tender." If confined, cattle should be fed twice a day by the same persons, and not visited by strangers for at least a month. Feed each time only what the cattle will eat and vary the rations to stimulate the appetite. A little salt may be sprinkled on the food, but care should be taken not to give too much.

Scientific feeding.—Especial attention is called to certain points that need careful investigation. While in all the Southern States cotton seed and its products now have a great value as feeding stuffs, cotton-seed meal alone has been carefully studied as regards its digestible and nutritive value. The digestibility of cotton-seed hulls, the feeding value of which has been found within the past three years to be equal to a fair quality of hay, needs to be accurately determined. The nutritive value of the oil in the whole seed should also be studied. The tests made in the experiment reported in this bulletin all show the value of cotton seed for "rapidly loading up the steer with fat," and that cotton seed at $7 per ton is a cheaper feeding material than cotton-seed meal at $20. To make 1 pound of gain, pen 2 required 11.08 pounds of silage, 1.4 pounds of hay, 2.91 pounds of cotton-seed meal. Pen 6 required 6.74 pounds of cotton-seed hulls, 2.79 pounds of cotton-seed meal. Pen 7 required 5.84 pounds of cotton-seed hulls, 4.67 pounds of silage, 2.64 pounds of cotton-seed meal. This indicates that the hulls have a higher nutritive value than silage. Cotton-seed meal supplies what is lacking in the hulls, and cotton-seed meal and hulls should make a ration of high nutritive value, provided a considerable part of the hulls is digestible.

VERMONT.

Vermont State Agricultural Experiment Station.

Department of University of Vermont.

Location, Burlington. Director, W. W. Cooke, M. A.

BULLETIN No. 14, MARCH, 1889.

ANALYSIS OF FERTILIZERS LICENSED FOR SALE IN VERMONT FOR THE YEAR 1889, W. W. COOKE, M. A. (pp. 3–15).—This contains the trade values of fertilizing ingredients for 1889, as agreed upon by the stations in Massachusetts, Connecticut, and New Jersey; explanations of these values; fertilizer statistics for Vermont in 1888; a tabular record of analyses of twenty-eight licensed fertilizers, and a comparison of the average composition and value of licensed fertilizers for 1888 and 1889. Estimates based upon returns from one hundred and two railroad stations in the State indicate that about 4,200 tons of fertilizers, valued at about $150,000, were sold to Vermont farmers in 1888. The quality of the fertilizers sold in 1889 is about the same as in the previous year. The average selling price has decreased this year 33 cents per ton, but as the average value has also decreased just about as much the farmer gets the same fertilizing material for his money as last year.

BULLETIN No. 15, JUNE, 1889.

EFFECT OF FERTILIZERS ON THE COMPOSITION OF CORN, W. W. COOKE, M. A. (pp. 3–16).—In the experiments recorded in this article the intention was to test the wants of the soil by an analysis of the crops produced with different fertilizers.

The earth was dug out of a trench, 6 feet wide and 96 feet long, to the depth of 16 inches. The trench was then divided by a board partition into sixteen plats, each 6 feet square and 18 inches deep. When these were filled with dirt, each load was scattered as evenly as possible over the whole sixteen plats, to eliminate from the experiments all differences of soil. The soil used was a clay loam, gathered from the surface of recent plowed sod ground, and a load of clear sand was added to each two loads of the loam. When the ground had settled it was leveled, the fertilizer intended for each plat scattered broadcast over it, and then each plat spaded 6 inches deep, thus thoroughly and evenly working the fertilizer into the upper 6 inches of each plat. The two end plats and one near the middle were left without fertilizer, to serve as a basis for judging of the effect of the fertilizers of the other plats.

The fertilizers contained nitrogen, phosphoric acid, and potash, singly, two by two, and all three together. Nitrogen was furnished by nitrate of soda, sulphate of ammonia, and dried blood; phosphoric acid by superphosphate, phosphatic iron slag, and insoluble South Carolina rock; potash by muriate of potash. The crop was Sanford corn, which was cut before it was ripe to escape frost. Tables give details of first appearance of tassel, bloom, and silk; average height of stalk in inches at different dates; analysis of crop; weight of constituents of crop; per cent of each fertilizing ingredient in the dry matter of crop; weight of nitrogen, phosphoric acid, and potash per acre added to the land and subtracted in the crop.

The highest yields were with phosphoric acid, used alone or with other materials. Phosphatic (basic) slag gave fully as large yields as dissolved phosphate, and also produced much better results than undissolved South Carolina rock. Only when phosphoric acid was used was there a noticeable increase in the dry matter of the crop. The proportion of starch was highest when phosphoric acid was present in abundance in the fertilizer, and lowest when potash was used instead of phosphoric acid. The same was true regarding the amount of starch per plat.

Assuming that the differences in produce were due to the fertilizers, it appears that "addition of nitrogen alone increased the per cent of nitrogen or albuminoids in the crop; addition of potash or of nitrogen and potash did not change the per cent of nitrogen; addition of phosphoric acid alone or in combination lowered the per cent of nitrogen, but each time it so increased the weight of the crop as to actually take more nitrogen from the soil than when nitrogen compounds alone were used." To the question whether the analysis of the plant shows the needs of the soil a negative answer is given.

In several of the trials, although the amount of nitrogen supplied in the fertilizer was quite large, yet the crop contained even more nitrogen. This is in accord with the results of experiments on corn conducted some years ago in different parts of the country, which included several by the University of Vermont and State Agricultural College. These indicated that corn "did not need much artificial supply of nitrogen; that the nitrogen applied was almost always at a financial loss, and that if plenty of phosphoric acid and potash was given it would supply itself with nitrogen and make a good crop."

The same plats, without additional fertilizer, have been sown this year to peas and oats, to be followed by barley, rye, and grass. Each crop will be fully analyzed as above to see what effect is produced by the fertilizers and how long that effect can be traced.

Analysis of hay, W. W. Cooke, M. A. (pp. 17–20).—Analyses were made of samples of what was considered first-class hay from farmers in different parts of the State who had taken premiums in the butter exhibit at the meeting of the State Dairymen's Association in January, 1888. From the tabulated record of these analyses some conclusions are drawn, from which the following points are taken:

(1) The variation existing between samples of hay, all of which are considered good, extends to the fertilizing as well as the feeding value.

(2) Either because these samples were selected ones or because Vermont produces a superior quality of hay, the results of the analysis were better than those for the average of hay analyzed in other States. The probabilities are thought to favor the second season.

(3) In both fertilizing and feeding value the clover excelled the timothy.

(4) It is estimated that the fertilizing value of the early cut hay is much greater than that of the late cut. As the grass grows older the increase of substance is greater than the increase of the valuable fertilizing ingredients, and more of the latter are washed out and brought back into the soil by rain from the older than from the younger hay; hence, if hay is to be sold from the farm, that should be selected which was most fully matured when cut.

VIRGINIA.

Virginia Agricultural and Mechanical College Experiment Station.

Department of Virginia Agricultural and Mechanical College.
Location, Blacksburg. Director, William B. Preston.

BULLETIN No. 1, 1889.

Field experiments with fertilizers on wheat (pp. 1–19).—The chief object of these experiments was to observe the effects of nitrogen, phosphoric acid, and potash, singly; of phosphoric acid and potash together (mixed minerals), and of nitrogen when added in different forms and amounts to the phosphoric acid and potash. Phosphoric acid was supplied in acid phosphate, potash in kainit, and nitrogen as nitric acid in nitrate of soda, as ammonia in sulphate of ammonia, and as organic nitrogen in dried blood. The phosphoric acid and kainit were used at the rate of 400 pounds each per acre, the former containing 56 pounds of phosphoric acid, the latter 56 pounds of potash and the corresponding amount of chloride of sodium. Each form of nitrogen was applied by itself, and was also used in combination with the phosphoric acid and potash in three different amounts, "one-third ration," "two-thirds ration," and "full ration," supplying, respectively, 23 pounds, 46 pounds, and 69 pounds of nitrogen per acre. There were thus three groups of complete fertilizers in which nitrate of soda, sulphate of ammonia, and dried blood were used in turn in three different quantities, the amounts of mixed minerals remaining the same in all. Stable manure was also used at the rate of 30 tons per acre, and one plat was left unmanured.

The soil is "a calcareous clay, well drained, averaging 9 inches in depth, and underlaid with a stiff clay subsoil." As precautions to secure evenness of soil, the field, a clover sod from which the first crop had been removed, was plowed in September, 1886, and seeded to wheat, and "slight additions of manure were made wherever it was deemed necessary." It was divided into plats and seeded to wheat in September, 1887. These plats were again plowed in 1888, and Fultz wheat sown. The plats were one-fourth of an acre each, and separated by strips 4 feet in width.

In the order of heading out, the plat treated with acid phosphate was first. Taking this as a standard, that with mixed minerals was four days late; those without manure and with complete manures, six days; with nitrogen alone, eight days; and with stable manure, ten days. The relative order was the same in the ripening of the crop.

Tables are given showing the yield of grain and straw, the proportion of grain to straw, the quantities of nitrogen, phosphoric acid, and potash applied in the fertilizers and recovered in the crop, the cost of fertilizers, the value of the crop, and estimates of the increase in yield in each case over the yield of the unmanured plat, and the pecuniary profit or loss from the use of the fertilizers on the assumption that the increase with fertilizers was due to their action.

The following summary is condensed from the tabulated results:

	Valuable ingredients of fertilizers.			Produce.						Pecuniary results.			
				Total yield per acre.		Increase with fertilizers over no manure.		Increase with nitrogen over mixed minerals; or decrease (−).		Value of produce.	Cost of fertilizer.	Gain.	Gain with nitrogen, *i. e.*, with complete fertilizers, over mixed minerals; or loss (−).
	Nitrogen.	Phosphoric acid.	Potash.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.				
	Lbs	*Lbs*	*Lbs*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*				
Nothing	----	----	----	10.5	888	------	------	------	------	$11.25	------	------	--------
Nitrogen as—													
Nitrate of soda	69	----	----	18.1	1,384	7.6	496	------	------	19.09	$12.37	$6.72	--------
Sulphate of ammonia	69	----	----	15.7	1,568	5.2	680	------	------	17.30	12.67	4.63	--------
Dried blood	69	----	----	16.5	1,176	6.0	288	------	------	17.23	9.85	7.38	--------
Phosphoric acid (superphosphate)	----	56	----	26.8	1,312	16.3	424	------	------	26.74	2.60	24.14	--------
Potash (kainit)	----	----	56	21.3	1,392	10.8	504	------	------	21.98	2.20	19.78	--------
Phosphoric acid and potash (mixed minerals)	----	56	56	21.6	1,800	11.1	912	------	------	23.04	4.80	18.24	--------
Complete fertilizers, mixed minerals and nitrogen:													
Nitrate of soda group—													
One-third ration	23	----	----	32.5	2,632	22.0	1,744	10.9	832	34.54	8.92	25.62	$7.38
Two-thirds ration	46	----	----	37.1	3,856	26.6	2,968	15.5	2,056	41.07	13.05	28.02	9.78
Full ration	69	----	----	33.2	3,640	22.7	2,752	11.6	1,840	37.16	17.17	19.99	1.75
Sulphate of ammonia group—													
One-third ration	23	----	----	25.2	1,800	14.7	912	3.6	------	$26.28	$9.02	$17.26	−$0.98
Two-thirds ration	46	----	----	44.1	3,840	33.6	2,952	22.5	2,040	47.40	13.25	34.15	15.91
Full ration	69	----	----	44.0	4,120	33.5	3,232	22.4	2,320	47.84	17.47	30.37	12.13
Dried blood group—													
One-third ration	23	----	----	18.8	1,240	8.3	352	− 2.8	560	19.40	8.08	11.32	− 6.92
Two-thirds ration	46	----	----	41.6	3,504	31.1	2,616	20.0	1,704	44.45	11.37	33.08	14.84
Full ration	69	----	----	40.6	3,904	30.1	3,016	19.0	2,104	44.41	14.65	29.76	11.52
Average of three with—													
One-third ration	23	----	----	25.5	1,891	15.0	1,003	3.9	464	26.74	8.67	18.07	− .17
Two-thirds ration	46	----	----	40.9	3,733	30.4	2,845	19.3	1,933	44.31	12.56	31.75	13.51
Full ration	69	----	----	39.3	3,888	28.8	3,000	17.7	2,088	43.14	16.43	26.71	8.47
Stable manure	----	----	----	30.3	2,968	19.8	2,080	------	------	33.18	15.00	18.18	--------

The following are among the conclusions made on the assumption above referred to:

(1) As regards the yield: When the ingredients were applied singly the largest yield was with the phosphoric acid, the next largest with the potash, and the smallest with the nitrogen. Stable manure gave less returns than the complete fertilizers containing full and two-thirds rations of nitrogen.

(2) As regards the pecuniary profit or loss: Applied alone the phosphoric acid and potash were profitable and the nitrogen unprofitable. The complete fertilizers were profitable in all cases except those in which sulphate of ammonia, one-third ration, and dried blood, one-third ration, were used with mixed minerals: those with the full ration and with the two-thirds ration of sulphate of ammonia, those with the full ration and two-thirds ration of dried blood, and those with the two-thirds ration of nitrate of soda, were the most profitable. Stable manure was also profitable. Attention is drawn to the fact that the results of one season's work do not suffice for broad generalization.

WEST VIRGINIA.

West Virginia Agricultural Experiment Station.

Department of West Virginia University.

Location, Morgantown. Director, John A. Myers, Ph. D.

BULLETIN No. 4, MARCH, 1889.

The creamery industry: its adaptability to West Virginia, A. C. Magruder, B. S. (pp. 89–121).—Attention is called to the natural advantages possessed by this State, which are likely to make the creamery industry successful. The arable lands of a large part of the State are very hilly and cultivated with great difficulty. It would be much more economical to convert these steep hillsides into pastures than to continue the attempt to raise wheat, corn, or hay on them. The success of the comparatively few men in West Virginia who have thus far adopted this plan of farming confirms this view. To show the relative profitableness of dairying, the estimated value of the product of 10 acres in wheat or corn for ten years is compared with that from four cows kept on the same area during the same time. The gross receipts for the wheat crop in ten years are estimated to be $2,280, and for the corn crop $2,150. The four cows will have produced in ten years butter, cheese, skim-milk, buttermilk, and calves, to the value of $3,185, besides the manure, which would be a large additional item. When wheat or corn is raised year after year, the land steadily runs down and produces less and less, while on the other hand, dairying would enhance the productiveness of the farms and give a larger money return from the products of the milk.

To show what plant is necessary for a creamery, the bulletin gives "a complete list of apparatus of a creamery for manufacturing the milk of from one hundred to two hundred cows, and also for a creamery with a capacity to manufacture the milk of from two hundred to five hundred cows, and a plan for a creamery building, with specifications so detailed that any ordinary carpenter can erect the building with little trouble, as all the material to be used is specified." These plans are illustrated with diagrams. The centrifugal separator is described and a system of checks for keeping accounts between the creamery and its patrons is proposed. The creamery business is further discussed under the following topics: "How private and co-operative creameries are conducted," "Mode and value of testing milk," "Plans of organization," "What is the advantage of a creamery in a community?" Farmers are urged to apply the creamery tests to the individual cows of their own herds, so as to find out which of their cows are not profitable. A plan is suggested for an organization of farmers, and the Station offers personal assistance in the establishment of new creameries.

BULLETIN No. 5, JUNE, 1889.

THE SELECTION OF MILCH COWS, A. C. MAGRUDER, B. S. (pp. 124–139) (illustrated).—This bulletin was prepared with a view to assisting farmers in the selection of "cows for supplying milk to creameries where butter is the main product of manufacture." It contains an account of the "points usually possessed by good milch cows," and explanations of the "escutcheon or milk-mirror" and of the "methods used in determining the age of cattle," compiled in large part from Flint's "Milch Cows and Dairy Farming," from which work are also taken the plates used to illustrate the bulletin.

WISCONSIN.

Agricultural Experiment Station of the University of Wisconsin.

Department of University of Wisconsin.

Location, Madison. Director, W. A. Henry, B. Agr.

BULLETIN No. 18, JANUARY, 1889.

THE CONSTITUTION OF MILK, AND SOME OF THE CONDITIONS WHICH AFFECT THE SEPARATION OF CREAM, S. M. BABCOCK, PH. D. (pp. 3–35).—The chief feature of this bulletin is the discussion of fibrin in milk, and the ways in which it affects the formation of cream. Preliminary to this, however, the importance to farmers of a knowledge of the nature of milk is urged. The bulletin also explains the chemical composition of milk, discusses the milk serum, which contains the albumen, casein, milk sugar, salts, and other "solids not fat" of the milk; describes the fat globules, giving statistics of their size and number; calls attention to the small proportion of fat in the first milk and the large proportion in the strippings, showing how it increases with increase of solids not fat in the milk serum, and how it tends to retard the rise of fat globules in creaming; explains the viscosity of milk; illustrates the discussions by results of experiments at the Station and elsewhere; and shows the bearing of the facts upon the creaming of milk and the proper methods of handling milk and of making of butter.

Milk fibrin.—The announcement that besides casein and albumen there is in milk a nitrogenous compound similar to the fibrin of blood was made by the author in 1888.* To this he gives the name fibrin, milk fibrin, or lacto fibrin. The observations which led to this important conclusion and the chemical and other tests by which it is supported are stated in some detail in the bulletin.

The theory on which the author proceeds is, in brief, that the fibrin of milk, like that of blood, is an albuminous substance which separates by coagulation in the form of minute, elastic fibers. These make a network in which the corpuscles of blood or the fat globules of milk are entangled. In blood large clots are thus formed, while in milk, in which the amount of fibrin is extremely small, the clots are too minute to be seen with the naked eye. If milk is put under the microscope as soon as drawn, there is no appearance of fibrin and the globules are diffused uniformly through it; in other words, it has the appearance of a perfect emulsion of fat in milk serum. But fibrin forms soon and clots containing fat globules are speedily visible.

Observations and experiments cited indicate that in milk as ordinarily handled "the coagulation of fibrin begins at the surface and in contact with the sides of the vessel; that it is hastened by contact with any rough surface, by agitation, and by exposure to air; and that it is retarded by cold and by certain chemicals." Since the amount of fibrin in normal milk is very small, the influence of its weight alone in promoting the rise of fat would not be very important. Indirectly, however, these clots have a decided influence, "entangling not only the fat, but the other matters, solid and gelatinous, in the milk, which are either carried into the cream, or, if the solid portions are too heavy, are prevented from rising at all." In short, the clots of milk fibrin with the fat globules entangled in them are slower to rise than are the fat globules when alone and untrammeled by the fibrin. Hence fibrin tends to hinder the creaming of milk. Whatever tends to favor the formation of fibrin clots or to prevent their rising when formed is, in so far, unfavorable to the rising of cream. Whatever tends to prevent the formation of fibrin is helpful to creaming.

Observations with the microscope, experiments with artificial emulsions, and chemical tests developed marked analogies between the fibrin of milk and that of blood. In both milk and blood the formation of fibrin and the grouping of corpuscles begins after the milk or blood is drawn, and can be prevented by sodium and potassium hydrates or by various salts. Artificial emulsions with no material to supply fibrin showed no tendency to grouping, but when blood serum, so prepared that fibrin would form in it, was added to such an emulsion the globules grouped exactly as in milk. For chemical tests peroxide of hydrogen and guiacum were used and the reactions of milk and blood fibrin were very similar.

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* In a paper read at Cleveland, Ohio, August, 1888, before the Society for the Promotion of Agricultural Science.

The effects of temperature upon the specific gravities of fat and milk serum and upon the viscosity of milk are discussed and experiments described. The viscosity is found to decrease as the temperature rises. High temperature would, therefore, be favorable to creaming if it were not for the formation of fibrin, which is aided by the high, and hindered by low, temperature. With the centrifugal separator the effect of the centrifugal force is to increase "the effective difference in weight" between the lighter fat globules and the heavier fibrin. The fat globules move quickly to the center and escape entanglement by the fibrin, while the latter gathers to a greater or less extent on the drum of the centrifugal; hence, high temperature favors creaming with the centrifugal. The formation of fibrin helps to explain the delay in setting of milk. When milk stands for some time before cooling, fibrin forms, and the fat globules are entangled in the clots and rise slowly. Warming the milk again after it is cool does not mend the matter, because it does not integrate the fibrin clots. But if milk is cooled on ice as soon as drawn from the cow the fibrin does not form so quickly and creaming is more complete.

Coagulation of fibrin may be prevented by various chemicals, as is clearly illustrated by figures from micro-photographs and by numerous experiments in which the cream rose rapidly from milk to which about one-tenth of 1 per cent of caustic soda was added. The fat left in the skim-milk was less and the butter product was greater when the caustic soda was added. The practical objections to the use of chemicals are that special training is required and that the value of the skim-milk is impaired.

The following conclusions are drawn by the author from his experiments and collateral considerations:

(1) That milk when fresh is a perfect emulsion, the fat globules being free and without an envelope.

(2) That the chief differences in the composition of normal milks are due to variations in the amount of fat, the remainder of the milk, known as the milk serum, being quite uniform in composition in all milks. The variation in the amount of serum solids in milk from the same cow is rarely more than one-half per cent, in milk from different cows of the same breed it is usually less than 1 per cent, and in milk from cows of different breeds not more than 2½ per cent. This holds true even when the fat varies as much as 7 or 8 per cent.

(3) That milk contains a principle analogous to or identical with blood fibrin which is capable of spontaneous coagulation, the clots of which entangle the fat globules and to a considerable extent prevent an efficient creaming.

(4) That the most efficient creaming is obtained when conditions are supplied which retard or prevent the coagulation of fibrin. This may, in practice, be best accomplished by setting the milk directly after milking in cold water, the creaming vessel to be of bright tin or other metal that can easily be kept clean.

(5) When the milk is transported, or when for any reason the setting must be delayed, no method of creaming gives as satisfactory results as the centrifugal.

In this investigation the author lays but little emphasis upon the action of ferments in the coagulation of fibrin. The investigations of Professor Conn, reported in Bulletin No. 4 of the Storrs School Agricultural Experiment Station, have called attention anew to the action of bacteria in milk. These two investigators, then, are approaching the same subject, but from different standpoints. What is now wanted is the further study of the fermentation in milk. Among the questions that need investigation are:

(1) Does normal milk contain a ferment (or ferments) analogous to the fibrin ferment which has been assumed to cause the coagulation of blood? If so, is this ferment contained in the milk as the latter is elaborated in the lacteal glands, or is it acquired from the air after the milk is drawn from the cow? Is it an unorganized ferment, independent of bacteria or other organisms? What are the conditions under which the action of the ferment is exercised? What are the changes in milk which it causes?

(2) What bacteria and other organisms which cause fermentation does milk receive from air? Under what conditions do they act and what changes do they cause in milk and cream? The solution of these and kindred questions will require profound, painstaking, and long continued experimental study; but that study is indispensable. The attempt to get at a satisfactory explanation of the processes involved in the formation and ripening of cream, the souring and coagulation in milk, and the making of butter and cheese without an understanding of the nature and the action of the ferments and the processes of fermentation in milk is work in the dark. This is simply one of the many illustrations of the need of abstract research to explain processes of the greatest importance, and to make the practical application most feasible and most successful.

BULLETIN No. 19, APRIL, 1889.

INTRODUCTION—NOTES ON SILAGE, W. A. HENRY, B. AGR. (pp. 3, 4).—Although there are now probably 2,000 silos in the State, the demand for information on this subject is greater than ever. The object of this bulletin is to answer inquiries received by the Station.

> From our correspondence and reports gathered at institutes it is plain that nineteen farmers out of twenty who have used the silo are well pleased with this method of food preservation, though all have not been able to secure first-class silage.

While we already know much about the silo, very much remains to be found out. The high temperature developed in the silo as at present managed involves waste. How to prevent this is still a problem. To produce "sweet" silage, which seems very desirable, the essential condition appears to be that the corn be well matured, *i. e.*, that it contain relatively little water. Farmers are warned not to feed corn silage exclusively, and the opinion is expressed that "the farmer who needs the silo is the one who is carrying a large number of cattle on a given area."

SILO BUILDING AND FILLING, L. H. ADAMS (pp. 5–15).—For economy in building and ease in handling the silage, the silo should be in the feeding barn if possible, otherwise adjoining it. A cubical silo will require less lumber and bring less silage in contact with the walls in proportion to its capacity than a long, narrow building. "Depth in a silo is always preferable to breadth." Directions for building a silo are given and illustrated with cuts. For painting the inside walls, coal-tar has worked well in one season's experience at the Station. "By the use of the old self-rake reaper for cutting in the field, and conveniently equipped wagons for hauling, corn can be put into the silo for from 50 to 75 cents per ton." A convenient wagon rack for drawing fodder corn is described.

The length of the cutting desirable appears to turn upon somewhat closer packing on the one side and extra expense of fine cutting on the other. "While it is true that silage cut fine may pack somewhat closer than that cut long, it is doubtful whether there is any material gain" from very fine cutting. The greater exposure of the inner part of the finely cut stalks to the air may perhaps favor more fermentation, which is a disadvantage. There is no necessity of cutting silage fine in order to have it eaten. It is recommended that cuts as long as 2 or 3 inches be tried with some of the fodder and the results reported; the expense of making silage will be considerably decreased. If the corn is sufficiently mature, and is put into the silo without rain or dew, there need be no fears about the quality of the silage, whether put in slowly or rapidly. Only the immature fodder needs wilting. When the corn has dried so that the leaves rustle and break in handling, it is difficult to pack it so close as to exclude air sufficiently to prevent molding. "When filling is completed, a foot and a half of chaffed straw, marsh hay, or corn stalks will make sufficient covering. The use of weights is now about obsolete." If one crop, as clover, only partly fills the silo, another, as corn, may be placed over it.

VARIETIES OF CORN, CHANGES IN THE SILO, AND FEEDING RATIONS, F. G. SHORT (pp. 16–28).—*Varieties of corn for silage.*—The larger varieties do not usually ripen in Wisconsin. Tests were made with nine varieties of flint, dent, sweet, and so-called ensilage corn, in the endeavor to find a corn combining a fairly large yield with early ripening. They were planted in plats on well-prepared, rich land. Samples from an area of 120 square feet were taken for analysis. Comparing the total produce of the several plats with the composition, it appears that, judging by these tests, "at the date of cutting, September 6, the value of the corn acording to the yield of dry matter, would be in the following order, beginning with the highest: Southern Horse Tooth, Southern Ensilage, Smedley Dent, Normandy White Giant, Fargo Brothers' Ensilage, B. & W. Ensilage, Sibley's Sheep Tooth." The season, however, was exceptionally favorable to the growth of Southern and adverse to the Northern varieties. Tests of another season, especially if it be cold and rainy, may change the order materially.

The weight of green fodder per acre is no indication of the true value of the corn, since the differences in the percentage of water and actually nutritive substance are very wide. The large, rank-growing varieties are apt to be watery. As the corn matures the proportion of water decreases and that of dry substance increases very materially. The ordinary varieties of field corn, either dent or flint, will prove satisfactory for silage, but the Station favors smaller varieties than have usually been used for silage, and no variety that will not mature in ample time to be gathered into the silo before there is danger of frost.

Thickness of planting.—"The corn should be planted so thin that considerable grain will mature." The tendency now is toward thinner planting. For the large varieties the rows should be 4 feet apart, with single kernels at intervals of 8 inches. With smaller varieties rows should be 3½ feet apart, with the grains at intervals of 6 inches. Flint corn, planted 3 grains to the hill, with hills 2 feet apart, in rows 3½ feet apart, will give a large crop of fodder and grain.

Time of cutting.—"Repeated experiments have shown that to obtain the maximum amount of nutritive matter the corn must be allowed to reach a certain degree of maturity." Corn at "the point of glazing has nearly twice as much nutritive matter to the ton as that cut when the ears are just beginning to show the tassel." It should be "sufficiently matured to have obtained its maximum growth, without having lost its succulence: this condition is obtained when the kernel of the ear is glazed so as not to be easily dented with the nail;" in other words, "when the corn has just passed the glazing stage in the flint, and is well dented in the dent corns." Experiments and analysis indicate, further, that corn cut at this stage is in the best possible condition for the silo, "an important point being that the small proportion of water in the mature corn is favorable to good preservation in the silo and the production of sweet silage."

Changes in the silo.—These are caused by fermentation, which is favored by the presence of air and causes loss of nutritive substance. In 1887–88, the loss of dry matter in the Station silos ranged from 14.7 to 31.8 per cent. In some cases air had evidently leaked in through the sides of the silos and made the loss greater than it otherwise would have been. The heat generated by fermentation of silage is an indication of loss of nutritive substance. Some loss is inevitable. To prevent excessive fermentation it is important to spread the silage evenly and tread it down compactly in the silo. "Every air space filled and every loose corner well pressed down is the removal of a chance for molded and rotten silage."

Temperature and condition of silage—Acidity—Experiments at the Station.—Trials were made in 1888–89 with six experimental silos at the Station, four being filled with corn. Iron tubes were placed in the silage so that the temperature at different depths could be measured by thermometers. The acidity of the silage was determined by analysis. No definite relation was found between the acidity and the temperature. Silage of high degree of acidity and offensive odor was formed where the temperature ranged as high as 150° F., while sweet silage of fine quality with very slight acidity has been made when the temperature has not risen above 80° F. In the experience of the Station, sweeter and better silage has been made from year to year. The grain has been put in when more and more mature, and hence containing less and less water. This observation suggests that small water content is favorable to the production of sweet silage. "Examination of the analyses of silage received from various silos in the State, as well as our own, would seem to indicate that the acidity varies with the amount of water present in the grain; the more water, the greater the per cent of acid." A table of analyses enforces this proposition in a very striking manner. In these figures we read a strong argument in favor of mature and well-grown fodder corn for the silo. "If this theory is correct, sweet silage then depends upon maturity of the corn and the exclusion of air rather than upon any particular variety of corn or method of filling."

Opening the silo.—The silo should remain closed until the maximum heat has been attained and the temperature has been considerably reduced. In general, it is not advisable to open a silo within one month after filling.

Feeding rations.—Silage should not be fed exclusively. Like corn, it is "not a perfect food," but requires other materials rich in nitrogen to be fed with it in order to obtain the best results. To show in what proportions other feeding stuffs may be properly fed to cows with the silage, mixtures of bran, malt sprouts, brewers' grains, oil meal, corn meal, oats, clover hay, and straw are given in a table. With these "partial rations," 40 or more pounds a day of silage, made from well-matured, well-eared corn, are to be fed. The practice of putting layers of straw between those of corn silage in the silo is condemned. Clover is strongly recommended for silage. It should be cut when quite mature and when the dew is off. It does not need to be put through a cutting machine, so that the expense of filling the silo with this crop is very light.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE, ISSUED IN 1889.

PART II.

DIVISION OF BOTANY.

BULLETIN No. 8, FEBRUARY, 1889.

A RECORD OF SOME OF THE WORK OF THE DIVISION (pp. 67).—PART I, BY DR. GEORGE VASEY.

Grass experiment stations (pp. 9–16).—The first of the grass experiment stations provided for by Congress has been located at Garden City, Kans., upon 160 acres of prairie land leased free to the Government for five years. Dr. J. A. Sewall, of Denver, Colo., is the director of the station. The experiments in progress are primarily to ascertain what plants are best adapted for cultivation for grazing purposes on the 76,000,000 acres of arid plains in Eastern Colorado, Western Kansas and Nebraska, and Southern Wyoming. This article contains a list and short descriptions of some of the grasses which will be experimented with.

Notes on grasses (pp. 16, 17).—A short account of the common grasses of the prairies. The most abundant and widely spread ones are *Stipa spartea* (porcupine grass), *Panicum virgatum*, *Kœleria cristata*, *Andropogon provincialis* (blue stem), and *Andropogon scoparius*.

Botanical notes (pp. 18, 19).—Extracts from correspondence, giving accounts of several newly reported weeds, and some grasses not previously supposed to be of economic importance.

The genus Panicum in the United States (pp. 20–39).—A revision, with technical descriptions and notes on geographical distribution, of the sixty-four species of this genus of grasses in the United States.

PART II, BY B. T. GALLOWAY.

Some diseases of plants (pp. 45–67).—This contains papers on potato scab, gum disease of the orange, fungi of Missouri, and extracts from correspondence relative to the following diseases and their treatment: black rot of the grape, apple scab and rust, pear blight, melon rust, anthracnose of the bean, etc.

SECTION OF VEGETABLE PATHOLOGY.

BULLETIN No. 9.

PEACH YELLOWS, ERWIN F. SMITH (pp. 254), (plates 37, maps 9).—This bulletin consists of a detailed discussion of the history and characteristics of this disease, the losses due to it, the conditions supposed to favor it, and conclusions as to its cause. Considerable space is also given to a consideration of the effect of restrictive legislation in preventing the spread of this disease.

QUARTERLY BULLETIN, MARCH, 1889.

JOURNAL OF MYCOLOGY, VOL. V, No. 1 (pp. 50), (plates 8).—This contains papers by Dr. B. D. Halsted, B. T. Galloway, E. F. Smith, Kellerman and Swingle, Etta L. Knowles, E. S. Goff, and others, on *Peronosporeæ* and rain-fall in Iowa; new species of Kansas fungi; the abnormal structure induced by *Ustilago zeæ mays;* synopsis of North American species of *Nummularia* and *Hypoxylon;* spotting of peaches; treatment of apple scab and gooseberry mildew; reviews of recent literature, etc.

Professor Goff reports the successful treatment of gooseberry mildew and apple scab with a solution of sulphide of potassium, one-half an ounce to a gallon of water. Mr. Galloway gives an account of similar results obtained with the same remedy in combating the bitter rot of the apple, and also calls attention to the fact that plum-leaf rust and tomato rot were successfully treated in 1889 with the Bordeaux mixture.

QUARTERLY BULLETIN, JUNE, 1889.

JOURNAL OF MYCOLOGY, VOL. V, No. 2 (pp. 51–111), (plates 2).—This contains papers on *Glœosporium nervisequum*, Fckl.; history of the development of the *Pyrenomycetes;* North American Agarics; new fungi; *Sphærotheca phytoptophila; Mucronoporus;* notes on miscellaneous subjects; and reviews of recent literature. B. T. Galloway reports the results of an experiment in burying the spores of the black rot fungus. He found that spores buried from 4 to 6 inches for six months were completely destroyed.

QUARTERLY BULLETIN, SEPTEMBER, 1889.

JOURNAL OF MYCOLOGY, VOL. V, No. 3 (pp. 113–180), plates 2).—This contains papers on the history and development of the *Pyrenomycetes;* peach rot and blight; North American Agarics; new fungi; remedy for potato rot; miscellaneous notes; and reviews of recent literature. An account is given of the successful treatment of potato rot by spraying the vines with Bordeaux mixture to which London purple had been added. In this way the rot and the Colorado beetle were combated at the same time.

Journal of Mycology, Vol. V. No. 4 (pp. 181–249), (plates 2).—This contains papers on the history and development of the *Pyrenomycetes;* the *Erysipheæ* of Montana; root fungus of New Zealand; *Peronosporeæ* for 1889 in New Jersey; prevalence of Ergot in 1889; treatment of black rot of the grape and of apple scab; *Erysipheæ* upon *Phytoptus* distortions; miscellaneous notes; reviews of recent literature; and indexes for Volume V of the Journal.

BULLETIN No. 10.

Report on experiments made in 1888 in the treatment of downy mildew and black rot of the grape-vine (pp. 61), (plates 2).—This embraces the reports of the special agents of the section, who conducted experiments under direction of the chief. It contains an account of the first successful treatment of black rot, a disease which has ravaged the vineyards of the country for more than forty years.

CIRCULAR No. 7, AUGUST, 1889.

Grape-vine diseases, B. T. Galloway (pp. 4).—A popular account of the downy mildew, brown and gray rot, powdery mildew, anthracnose, bitter rot, black rot and white rot, designed especially to aid in identifying these diseases.

CIRCULAR No. 8, SEPTEMBER, 1889.

Experiments in the treatment of pear-leaf blight and apple powdery mildew, B. T. Galloway (pp. 11), (figs. 2).—This contains (1) accounts of the treatment of 500,000 pear seedlings for leaf blight with the Bordeaux mixture, containing 6 pounds of sulphate of copper and 4 pounds of lime to 22 gallons of water. Five applications, made at a total cost of $22, resulted in the entire freedom of the treated trees from blight, while those untreated blighted badly. (2) Accounts are also given of the treatment of 400,000 apple seedlings for apple powdery mildew. Six applications of an ammoniacal solution of sulphate of copper were made at a cost of $30.80. There was practically no mildew on the treated trees, while those not treated were considerably injured.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

NOVEMBER 15, 1889, TO JANUARY 15, 1890.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Bulletin No. 4.—List of Horticulturists of the Agricultural Experiment Stations in the United States, with an Outline of the Work in Horticulture at the Several Stations.

DIVISION OF STATISTICS:

Report No. 68, new series, November, 1889.—Yield of Crops per Acre.

Report No. 69, new series, December, 1889.—Crops of the Year.

DIVISION OF ENTOMOLOGY:

Periodical Bulletin.—Vol. II, No. 6.—Insect Life.

Special Bulletin.—The Horn Fly (reprint from Insect Life, Vol. II, No. 4).

DIVISION OF BOTANY:

Special Bulletin.—The Agricultural Grasses and Forage Plants of the United States (revised and enlarged edition).

LIST OF STATION BULLETINS OF 1889 RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

NOVEMBER 15, 1889, TO JANUARY 15, 1890.

ALABAMA.

Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama:

Bulletin No. 6 (new series), July, 1889.—Grasses of Alabama and their Cultivation.

Bulletin No. 7 (new series), October, 1889.—Methods of Setting Milk; Tests of Varieties of Vegetables; Data from Soil Thermometers.

Bulletin No. 8 (new series), November, 1889.—Commercial Fertilizers.

Bulletin No. 9 (new series), December, 1889.—Science Contributions, Vol. I, No. 1.

A Preliminary Report upon the Life History and Metamorphoses of a Root-Gall Nematode, *Heterodera radicicola* (Graeff) Müll., and the Injuries Caused by it upon the Roots of Various Plants.

ARKANSAS.

Arkansas Agricultural Experiment Station:

Bulletin No. 11, September, 1889.—Tests of Varieties of Strawberries and Wheat; Fertilizers on Oats.

CALIFORNIA.

Agricultural Experiment Station of the University of California:

Bulletin No. 84, December, 1889.—Distribution of Seeds and Plants.

CONNECTICUT.

The Connecticut Agricultural Experiment Station:

Bulletin No. 100, September, 1889.—Analyses of Sylvanit, Wood Ashes, Nitrogenous Superphosphates, Guanos, and Specjal Manures.

DELAWARE.

The Delaware College Agricultural Experiment Station:

Bulletin No. 6, October, 1889.—Black Rot of Grapes; Remedies.

INDIANA.

Agricultural Experiment Station of Indiana:

Bulletin No. 29, December, 1889.—Grasses of Indiana.

IOWA.

Iowa Agricultural Experiment Station:

Bulletin No. 7, November, 1889.—Experiments with Corn; The Millets; Sugar Experiments; New Cynipidæ; The Hog Louse; The College Vineyard.

LOUISIANA.

STATE EXPERIMENT STATION:

Bulletin No. 25.—Analyses of Commercial Fertilizers, etc.

MARYLAND.

MARYLAND AGRICULTURAL EXPERIMENT STATION:

Special Bulletin, Fair Edition, 1889.—Facts About the Station.

MASSACHUSETTS.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 35, November, 1889.—Meteorology; Feeding Experiments with Milch Cows.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Special Bulletin, November, 1889.—The Gipsy Moth.

MICHIGAN.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:

Bulletin No. 54, October, 1889.—Experiments and Observations on the Jack-Pine Plains.

MINNESOTA.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA:

Bulletin No. 9, November, 1889.—Russian Willows and Poplars—Descriptions and Value for Minnesota. Insects Affecting Willows and Poplars.

MISSOURI.

MISSOURI AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 9, December, 1889.—Study of the Life History of Corn at its Different Periods of Growth.

NEBRASKA.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:

Bulletin No. 11, December, 1889.—The Smut of Wheat and Oats; The Smut of Indian Corn; A Preliminary Enumeration of the Rusts and Smuts of Nebraska; Notes on the Fungi of Economic Interest Observed in Lancaster County, Nebr., during the Summer of 1889; Observations on the Cotton-wood (*Populus monilifera*, Ait.).

NEVADA.

NEVADA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 6, September, 1889.—Meteorological Report for July, August, and September, 1889.

NEW HAMPSHIRE.

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 8, November, 1889.—Feeding Experiments—Principles of Feeding; Corn Meal, Middlings, Shorts, and Cotton Seed Compared.

NEW JERSEY.

NEW JERSEY STATE AND COLLEGE AGRICULTURAL EXPERIMENT STATIONS:

Special Bulletin, October 28, 1889.—Questions Relative to General Farm Practice.

NEW YORK.

New York Agricultural Experiment Station:

Bulletin No. 16 (new series), July, 1889.—A Study of the Corn Plant; Lucern or Alfalfa.

Bulletin No. 17 (new series), October, 1889.—Cattle Foods and Feeding Rations.

Cornell University Agricultural Experiment Station:

Bulletin No. 10, October, 1889.—Tomatoes.

Bulletin No. 11, November, 1889.—On a Saw-Fly Borer in Wheat.

Bulletin No. 12, December, 1889.—A New Apparatus for Drying Substances in Hydrogen and for the Extraction of the Fat.

Bulletin No. 13, December, 1889.—On the Deterioration of Farm-Yard Manure by Leaching and Fermentation; On the Effect of a Grain Ration for Cows at Pasture.

NORTH CAROLINA.

North Carolina Agricultural Experiment Station:

Bulletin No. 65, August–September, 1889.—Co-operative Field Tests during 1888.

Bulletin No. 66, September 15, 1889.—Stock Feeding as Practiced in North Carolina; Indian Corn.

OHIO.

Ohio Agricultural Experiment Station:

Bulletin Vol. I, No. 1, Technical Series, October, 1889.—Preparatory Stages of the 20-Spotted Ladybird; Studies in Pond Life; A Partial Bibliography of Insects Affecting Clover.

OREGON.

Oregon Experiment Station:

Bulletin No. 3, October, 1889.—Practical Work with Insecticides; Corn Worm; Insecticides; Spraying Machines; Directions for Sending Insects; Some Investigations on Plants Poisonous to Stock.

PENNSYLVANIA.

The Pennsylvania State College Agricultural Experiment Station:

Bulletin No. 9, October, 1889.—Digestibility of Corn Fodder and Silage.

SOUTH DAKOTA

South Dakota Agricultural Experiment Station:

Bulletin No. 15, November, 1889.—Forestry.

TENNESSEE.

Tennessee agricultural Experiment Station:

Bulletin Vol. II, No. 4, October, 1889.—Grasses of Mountain Meadows and Deer Parks; Chemical Composition and Tests of Varieties of Strawberries.

Special Bulletin B, October 15, 1889.—Analyses of Commercial Fertilizers.

VERMONT.

Vermont State Agricultural Experiment Station:

Bulletin No. 17, October, 1889.—Test of Dairy Cows at Vermont State Fair.

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31

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W. O. ATWATER, DIRECTOR

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TABLE OF CONTENTS.

Page.

Editorial notes 175

Statistics of the German agricultural experiment stations 175

Abstracts of Station Bulletins, July–December, 1889, Part I 183

ALABAMA:

Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama 183

Bulletin No. 6 (new series), July, 1889 183

Grasses of Alabama and their cultivation, P. H. Mell, Ph. D 183

Bulletin No. 7 (new series), October, 1889 184

Experiments with methods of setting and churning milk, Isaac Ross 184

Experiment in setting milk *vs.* creaming with the De Laval separator, J. W. Hart 184

Experiments with varieties of vegetables, James Clayton 184

Data from soil thermometers, P. H. Mell, Ph. D 184

Directions for sending specimens of diseased plants and of insects to the Station, G. F. Atkinson, Ph. B 184

Bulletin No. 8 (new series), November, 1889 184

Commercial fertilizers, N. T. Lupton, LL. D 184

Bulletin No. 9 (new series), December, 1889 185

Nematode root-galls, G. F. Atkinson, Ph. B 185

Canebrake Agricultural Experiment Station 187

Bulletin No. 4, April, 1889 187

Experiments with cotton, W. H. Newman, M. S 187

Meteorological observations 187

Bulletin No. 5, July, 1889 187

Experiments with fertilizers on oats, W. H. Newman, M. S 187

Experiments with wheat, W. H. Newman, M. S 187

Meteorological report 187

Bulletin No. 6, October, 1889 188

Vegetables 188

Grapes 188

Meteorological report 188

ARKANSAS:

Arkansas Agricultural Experiment Station 188

Bulletin No. 11, September, 1889 188

Strawberries 188

Wheat 188

Oats 189

Page.

CALIFORNIA:

- *Agricultural Experiment Station of the University of California* — 189
  - Bulletin No. 83, November 1, 1889 — 189
    - The rise of the alkali in the San Joaquin Valley, E. W. Hilgard, Ph. D — 189
  - Bulletin No. 84, December 5, 1889 — 190
    - Distribution of seeds and plants, E. J. Wickson, M. A — 190

COLORADO:

- *Agricultural Experiment Station of Colorado* — 190
  - Bulletin No. 8, July, 1889 — 190
    - Alfalfa: its growth, composition, digestibility, etc — 190
  - Bulletin No. 9, October, 1889 — 191
    - Soils and alkali, D. O'Brine, D. Sc — 191

CONNECTICUT:

- *The Connecticut Agricultural Experiment Station* — 191
  - Bulletin No. 100, September, 1889 — 191
    - Sylvanit, unleached wood ashes and commercial fertilizers — 191
- *Storrs School Agricultural Experiment Station* — 192
  - Bulletin No. 4, July, 1889 — 192
    - Meteorological observations, E. A. Bailey — 192
    - Bacteria in milk and its products, H. W. Conn, Ph. D — 192
  - Bulletin No. 5, October, 1889 — 194
    - Atmospheric nitrogen as plant food, W. O. Atwater, Ph. D., and C. D. Woods, B. S — 194
    - Meteorological observations, E. A. Bailey — 195

DELAWARE:

- *The Delaware College Agricultural Experiment Station* — 195
  - Bulletin No. 6, October, 1889 — 195
    - Summary of the station's experiments on the black rot of grapes, A. T. Neale, Ph. D — 195
    - The black rot of the grape controlled by the Bordeaux mixture, F. D. Chester, M. S — 196
    - Botanical description of the black rot of the grape, F. D. Chester, M. S — 196
    - Notes on the black rot of the grape, M. H. Beckwith — 196
  - Bulletin No. 7, December, 1889 — 196
    - Stock feeding, A. T. Neale, Ph. D — 196

FLORIDA:

- *Agricultural Experiment Station of Florida* — 197
  - Bulletin No. 6, July, 1889 — 197
    - *Trifolium incarnatum* (crimson clover) and *Poa arachnifera* (Texas blue-grass), J. C. Neal, Ph. D — 197
    - Chemical analyses, J. M. Pickell, Ph. D., and J. J. Earle, B. A — 197
    - Plan of chemical laboratory and station headquarters — 198
  - Bulletin No. 7, October, 1889 — 198
    - Corn experiment — 198
    - Cucumbers — 198
    - Constituents of muck, J. M. Pickell, Ph. D — 198
    - General characteristics of muck, J. J. Earle, B. A — 198
    - Muck composting, J. C. Neal, Ph. D — 198

GEORGIA:

Page.

- *Georgia Agricultural Experiment Station* 198
  - Bulletin No. 4, July, 1889 198
    - Analyses of cattle foods, C. M. Strahan, M. E 198
  - Bulletin No. 5, October, 1889 198
    - Reorganization 198

ILLINOIS:

- *Agricultural Experiment Station of the University of Illinois* 199
  - Bulletin No. 6, August, 1889 199
    - A bacterial disease of corn, T. J. Burrill, Ph. D 199
  - Bulletin No. 7, November, 1889 200
    - The biology of silage, T. J. Burrill, Ph. D 200
    - Field experiments with oats, 1888–89, T. F. Hunt, B. S 202

INDIANA:

- *Agricultural Experiment Station of Indiana* 204
  - Bulletin No. 26, July, 1889 204
    - Wheat rust, H. L. Bolley, M. S 204
  - Bulletin No. 27, August, 1889 206
    - Field experiments with wheat, W. C. Latta, M. S 206
      - Comparison of varieties 206
      - Quantity of seed to the acre 206
      - Broadcast and drill seeding 206
      - Large and small seed 206
      - Continuous grain growing *vs.* rotation cropping 206
      - Suggestions to wheat growers 207
      - Weather summary 207
  - Bulletin No. 28, September, 1889 207
    - Smut of wheat and oats, J. C. Arthur, D. Sc 207
      - Stinking smut (*Tilletia lævis*) 208
      - Black smut (*Ustilago segetum*) 209
  - Bulletin No. 29, December, 1889 209
    - Grasses of Indiana, J. Troop, M. S 209

IOWA:

- *Iowa Agricultural Experiment Station* 209
  - Bulletin No. 6, August, 1889 209
    - Experiment station wheat and oats in 1889, R. P. Speer 209
      - Wheat 209
      - Oats 210
    - Feeding experiments with steers, G. E. Patrick, M. S., and L. P. Smith, M. S 210
      - A new form of recording desk 210
    - Food habits of the striped prairie squirrel (*Spermophilus 13-lineatus*), C. P. Gillette, M. S 211
  - Bulletin No. 7, November, 1889 211
    - Experiments with corn, R. P. Speer 211
    - Millets, buckwheats, and the new prolific tree bean, R. P. Speer 212
    - Sugar experiments, R. P. Speer 212
    - Codling moth experiments, C. P. Gillette, M. S 213
    - New Cynipidæ, C. P. Gillette, M. S 213
    - The hog louse (*Hæmatopinus suis*), C. P. Gillette, M. S 213
    - The college vineyard, J. L. Budd, M. H 213

KANSAS: Page.

Kansas Agricultural Experiment Station 214

Bulletin No. 7, July, 1889 214

Experiments with wheat, E. M. Shelton, M. S 214

Pasturing wheat 214

Experiments with varieties 214

Fertilizers and methods of cultivation 214

Salt applied to oats, E. M. Shelton, M. S 215

Listing wheat, E. M. Shelton, M. S 215

Bulletin No. 8, October, 1889 216

Preliminary report on smut in oats, W. A. Kellerman, Ph. D., and W. T. Swingle 216

Bulletin No. 9, December, 1889 216

Experiment in pig feeding, E. M. Shelton, M. S., and H. M. Cottrell, M. S 216

KENTUCKY:

Kentucky Agricultural Experiment Station 218

Bulletin No. 20, July, 1889 218

Commercial fertilizers, M. A. Scovell, M. S 218

Bulletin No. 21, September, 1889 218

Experiments with wheat 218

Tests of varieties 218

Methods of seeding 218

Field experiments with fertilizers on wheat 218

The grain louse (*Siphonophora avenæ*), H. Garman 219

Bulletin No. 22, December, 1889 219

Potato experiments in 1889 219

LOUISIANA:

Sugar, State and North Louisiana Experiment Stations 220

Bulletin No. 24 (State Station) 220

Rice and its by-products, W. C. Stubbs, Ph. D 220

Composition of rice and the various products of the rice milling process, B. B. Ross, M. S 221

Bulletin No. 25 (State Station) 221

Analyses of commercial fertilizers and other substances useful to agriculture, W. C. Stubbs, Ph. D 221

MARYLAND:

Maryland Agricultural Experiment Station 222

Special bulletin (fair edition, 1889) 222

Facts about the station, Henry E. Alvord, C. E 222

MASSACHUSETTS:

Massachusetts State Agricultural Experiment Station 222

Bulletin No. 35, November, 1889 222

Meteorological summary 222

Feeding experiments with milch cows, C. A. Goessmann, Ph. D 222

Net cost of feeding stuffs 223

Nutritive value of feeding stuffs 223

Conclusions 224

Hatch Experiment Station of the Massachusetts Agricultural College 224

Bulletin No. 5, July, 1889 224

Household pests, C. H. Fernald, Ph. D 224

MASSACHUSETTS—Continued. Page.
Hatch Experiment Station of the Massachusetts Agricultural College.—Continued.
Bulletin No. 6, October, 1889 225
Greenhouse heating—steam *vs.* hot water—S. T. Maynard, B. S 225
Strawberries, test of varieties, S. T. Maynard, B. S 225
Fungous diseases of plants, J. E. Humphrey, B. S 225
Meteorological bulletins, Nos. 1–12, January–December, 1889 225
Special bulletin, November, 1889 225
The Gipsy moth (*Ocneria dispar*, L.), C. H. Fernald, Ph. D 225
MICHIGAN:
Experiment Station of Michigan Agricultural College 226
Bulletin No. 51 (Station), July, 1889 226
Enemies of the wheat aphis, A. J. Cook, M. S 226
Bulletin No. 52 (Station), July, 1889 226
Commercial fertilizers, R. C. Kedzie, M. D 226
Bulletin No. 53 (Station), August, 1889 227
Spraying with the arsenites, A. J. Cook, M. S 227
Insecticides for the plum curculio 227
Injury to foliage by arsenites 227
Poisoning the pasture under the trees 228
Bulletin No. 54 (Station), October, 1889 228
Experiments and observations on the jack-pine plains, W. J. Beal, Ph. D 228
Bulletin No. 55 (Station), December, 1889 228
Fruit testing at the South Haven substation, T. T. Lyon 228
MINNESOTA:
Agricultural Experiment Station of the University of Minnesota 229
Bulletin No. 8, July, 1889 229
Introduction, N. W. McLain, LL. B 229
Ensiling clover, N. W. McLain, LL. B 229
Sources of our home-made manures, W. M. Hays, B. S. A 229
The by-products of wheat, W. M. Hays, B. S. A., and D. N. Harper, Ph. D 230
The Rocky Mountain locust in Otter Tail County, Minnesota, in 1889, O. Lugger, Ph. D 230
Methods employed to kill the locust 231
Bulletin No. 9, November, 1889 232
Russian willows and poplars, S. B. Green, B. S 232
Insects affecting poplars and willows, O. Lugger, Ph. D 232
MISSISSIPPI:
Mississippi Agricultural Experiment Station 233
Bulletin No. 8, August 30, 1889 233
Stock feeding, B. Irby, M. S 233
Silos and silage 233
Chicken corn (*Sorghum vulgare*) *vs.* corn as food for mules 233
Feeding experiments with calves 233
Bulletin No. 9, August 30, 1889 233
Some entozoic diseases of sheep and calves, D. L. Phares, M. D 233
Helenium autumnale, D. L. Phares, M. D 233
Bulletin No. 10, October 10, 1889 233
Dehorning, D. L. Phares, M. D 233

Page.

Abstracts of publications of the United States Department of Agriculture, issued in 1889 ---- 235
Division of Chemistry ---- 235
Bulletin No. 21 ---- 235
Experiments in the manufacture of sugar by diffusion at Lawrence, Louisiana, in 1888–89, G. L. Spencer ---- 235
Bulletin No. 22 ---- 235
Experiments at Des Lignes Sugar Experiment Station, Baldwin, Louisiana, in 1888, C. A. Crampton ---- 235
Bulletin No. 23 ---- 236
Experiments at the sugar experiment station on Calumet Plantation, Pattersonville, Louisiana, in 1888–89, H. Edson ---- 236
Bulletin No. 24 ---- 237
Proceedings of Sixth Annual Convention of the Association of Official Agricultural Chemists ---- 237
Bulletin No. 25 ---- 237
A popular treatise on the extent and character of food adulterations, A. J. Wedderburn ---- 237
Bulletin No. 13, Part V ---- 238
Baking-powders, C. A. Crampton ---- 238
List of publications of the U. S. Department of Agriculture, January 15 to March 1, 1890 ---- 240
List of station publications, January 15 to March 1, 1890 ---- 241

EXPERIMENT STATION RECORD.

Vol. 1. **MARCH, 1890.** **No. 4.**

EDITORIAL NOTES.

STATISTICS OF THE GERMAN AGRICULTURAL EXPERIMENT STATIONS.

The following statistics of the German agricultural experiment stations have been compiled from accounts of these stations, given by Prof. Friedrich Nobbe, in Mentzel und Von Lengerke's *Landwirthschaftlicher Kalender* for 1890, and brought down to July, 1889. As indicated in the table, these stations are conveniently classed in two general divisions, viz: Those which belong to the Association of Agricultural Experiment Stations in the German Empire, and those which are outside the association. This association was founded in 1888 to promote the interests of the stations and their work throughout the Empire, and especially to secure uniformity in methods of investigation and inspection of fertilizers, feeding stuffs, seeds, etc. The purposes, indeed, are very similar to those of the American Association of Official Agricultural Chemists. Forty-three of the German stations are included in the membership of the association. Of the twenty stations outside the association but few are concerned with the special lines of work which the association promotes.

The first agricultural experiment station in Germany, and in the world, was established at Möckern, Saxony, in 1851. In 1861 there were nine stations; in 1871, twenty-three; and in 1881 at least fifty-three. The list given herewith contains sixty-three.

The income of the German stations is received from the general and provincial governments, from agricultural societies, from analyses of fertilizers, and from other sources. Complete financial statistics are not at hand. In 1889, according to the statistics here cited, twenty-five stations received from the government $49,103; ten stations received $5,165 from agricultural societies; thirteen stations received $31,526 from analyses of fertilizers, etc. The total revenues of twenty-two stations are here accounted for and amount to $153,928. A large number of the workers are officers of the universities and agricultural schools with which the stations are connected, and receive salaries from those institutions, which also, in many cases, furnish buildings and equipment. Furthermore, the stations in numerous instances supply dwellings for the members of the station staffs. The amounts here given must, therefore, fall very far short of representing the actual revenues of the stations.

Many of the stations are located in connection with educational institutions, but are separate in their organization. Others are practically departments of such institutions. Thus at Halle are two stations, both connected with the university. One is the station of the Agricultural Central Society of the Prussian province of Saxony. It was originally established under the auspices of that society on a farm at Salzmünde, some 8 miles from the city of Halle, but was transferred in 1865 to the Agricultural Institute of the University, one of whose professors is its director, and on whose grounds it has a large building for laboratories and residence of director and assistants. Besides this, the Agricultural Institute conducts experiments through its chief and his associates in the work of instruction, the organization ranking in this list as an experiment station. No account is made of the cost of work in the above financial statistics.

The working staffs of the stations include seventy-three directors and one hundred and forty-nine assistants, making a total of two hundred and twenty-two scientific specialists, besides five secretaries and a number of janitors, laborers, servants, etc.

Twenty-nine stations exercise control of fertilizers, twenty-seven of feeding stuffs, and thirty-three of seeds, by analyses and inspection of commercial wares. Four stations are charged with the inspection of foods and beverages. Eight stations are organized with especial reference to more purely scientific research. Fifteen are conducting investigations in vegetable physiology, nine in animal physiology and nutrition, two on soils, three in dairying, four in sugar-beet culture, two in fruit and vine culture, one in agricultural physics, eight in chemistry or chemical technology, four in agricultural technology, two upon commercial agricultural products (especially wine and tobacco), and three upon beer brewing. Nine of the stations have vegetation houses for experiments in vegetable physiology, nine have experimental fields, seven have feeding stalls for experimental purposes, four have experimental gardens, two have special arrangements for animals under experiment (Haustiergärten), two are equipped with Pettenkofer's respiration apparatus, and one with a horse dynamometer.

The German stations are like ours in the general character of their work, and in the fact of their connection with educational institutions, but since the latter institutions are under the control of the government, which also supplies a large amount of the revenues of the stations and appoints many of their officers, the stations are more directly subject to governmental supervision than ours. It should be observed that agricultural societies exercise the most important influence in their management: many of the stations were established by these societies and receive a considerable portion of their revenue from them. The revenues are smaller than ours, as are salaries and other expenses. A much larger proportion of the revenue comes from analyses of fertilizers and other commercial products. In general, the German stations are more largely engaged than ours in the inspection of fertilizers, feeding stuffs, and seeds, and the expense of this is generally borne by societies, manufacturing firms, or individuals, especially in the case of the fertilizer analyses.

Among the most marked differences are the greater specialization of work and the relatively larger proportion of abstract research in the German stations. The individual stations confine themselves to fewer subjects of investigation and study them more deeply. Relatively more attention is given to work in the laboratory, the greenhouse, and the stable, and less to that of the farm, garden, and orchard. This is the result of long experience under the conditions of agricultural and scientific development in which the German stations are placed. In their earlier history they specialized less, and more of their experimenting was done in the field, but they have learned the valuable lesson that the questions which the farmers ask require the most careful and oftentimes the most abstract research for their solution. Some of the largest and most successful of the stations were established originally on farms by associations of farmers, but have been transferred to the schools and universities in the cities, because the practical men by whom and in whose interest they were founded and are conducted have learned that in this way they do the most useful work.

It should be further noted that, besides the work of the stations above enumerated, a large amount of research bearing upon agricultural science and practice is carried on in Germany in the chemical, physiological, and botanical laboratories and institutes of the universities and agricultural schools and otherwise, as is also the case, though in less degree, in the United States.

Divisions of German Empire.	Location, city or town.	Date of organization.	Income.*				Working force.			
			From Government.	From agricultural societies.	From analyses, etc.	Total.	Directors.	Assistants.	Secretaries.	Janitors, servants, etc.
	Stations in the association.									
Prussia	Insterburg	1858	$1,375	$300	$1,500	----	1	2	----	----
	Königsberg	1875	1,375	----	2,250	----	1	2	----	----
	Königsberg (dairy laboratory of Agricultural Institute of University).	1887	----	----	----	----	2	3	----	----
	Danzig	1877	1,075	----	----	----	2	1	----	----
	Dahme	1857	2.550	----	----	----	1	3	----	----
	Regenwalde	1863	†1,725		----	----	1	2	----	----
	Eldena	1878	----	125	----	----	1	----	----	----
	Posen (by union of stations from Kuschen, 1861, and Bromberg, 1873).	1877	3,225	750	----	----	1	1	----	----
	Breslau (transferred from Ida-Marienhütte).	1877	1,125	----	----	----	1	3	----	----
	Halle (transferred from Salzmünde).‡	1865	1,500	----	10,750	12,250	1	10	1	5
	Halle (Agricultural Institute of University).	1863	----	----	----	----	1	4	----	----
	Kiel	1871	3,000	§850	2,125	5,975	2	5	----	----
	Kiel (Agricultural Institute).	----	----	----	----	----	1	----	----	----
	Göttingen	1857	2,500	----	----	----	3	2	----	----
	Göttingen (Agricultural Institute of University).	1876	----	----	----	----	1	----	----	----
	Hildesheim	1870	----	----	----	5,000	1	3	----	----
	Ebstorf	1871		----	----	----	1	----	----	----
	Münster	1871	2,825	590	3,275	6,690	1	6	----	----
	Marburg	----	----	----	----	----	1	2	----	----
	Wiesbaden	1881	----	----	----	----	1	1	----	----
	Geisenheim	1872	----	----	----	----	1	2	----	----
	Bonn	1856	1,785	----	4,920	6,750	1	4	1	2
	Poppelsdorf	1856	2,681	----	----	----	2	2	----	----
Bavaria	Munich	1857	----	----	----	3,500	1	3	----	2
	Augsburg	1865	----	1,125	1,181	2,481	1	1	----	----
	Würzburg	1877	----	----	----	1,000	1	1	----	----
	Speyer	1875	1,025	1,250	1,500	3,775	1	3	----	----
	Triesdorf	1874	475	----	----	----	1	1	----	----
Saxony	Möckern	1851	----	----	----	6,600	1	6	----	----
	Pommritz	1857	----	----	----	4,442	1	3	1	2
	Tharand	1869	2,500	75	500	----	1	4	----	1
Württemberg	Hohenheim	1865	2.750	----	500	----	1	2	----	----
Baden	Karlsruhe	1859	3,250	----	----	----	1	2	----	----
	Karlsruhe	1872	----	----	----	1,650	1	2	----	----
Hessen	Darmstadt	1871	----	----	----	6,250	1	2	----	----
Oldenburg	Oldenburg	1876	----	----	----	----	1	----	----	----
Brunswick	Brunswick	1862	----	----	----	3,750	1	2	----	----

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* One dollar equals 4 marks.

† Income from both government and agricultural societies.

stations of the German Empire, July, 1889.

Inspection.			Special lines of work.	Equipment.
Fertilizers.	Feeding stuffs.	Seeds.		
+	----	+	Vegetable physiology; inspection of foods and beverages.	
+	+	+	Scientific research	
----	----	----	Scientific research; dairying	Experimental dairy founded in 1887.
----	----	+	Scientific research; seed control	
+	+	+	Vegetable physiology (mainly)	
----	----	+	Vegetable physiology; soil investigations	Vegetation house.
+	+	+	Fertilizers; feeding stuffs; seeds	
+	+	+	Animal nutrition; plant culture; agricultural technology.	Vegetation house; stable to be built.
+	+	----	Vegetable and animal nutrition	Well-equipped laboratory in a building of Agricultural Institute of University.
+	+	+	Vegetable and animal nutrition; agricultural technology.	Large and well-equipped laboratory; vegetation house.
----	----	----	----	Physiological laboratory; experimental field; haustiergarten.
+	+	+	Animal and vegetable chemistry; tests dairy methods and apparatus, and gives instruction in dairying.	Chemical laboratory; experimental dairy; stables, etc.
----	----	+	Seed control	
----	----	----	Nutrition of animals	Pettenkofer's respiration apparatus; stables for cattle, sheep, swine, etc.
+	+	+	----	
+	+	+	Agricultural technology; experiments with fertilizers.	
+	+	+	----	
+	+	+	Scientific research	
----	----	+	Chemistry; seed control	
+	+	----	Scientific research	
----	----	----	Chemistry; vegetable physiology; fruit and vine culture.	
+	+	+	Inspection of foods; agricultural technology	
----	----	----	Chemistry; vegetable physiology	Separate laboratory and field for field experiments.
+	+	+	Animal and vegetable physiology	Laboratory; collections; experimental stables and garden.
+	+	+	Scientific investigations of fertilizers	
----	----	----	Vine culture; food investigations	
+	+	+	Inspection of foods and beverages; vegetable physiology; chemical technology.	
+	+	+	Agricultural technology	Vegetation house; experimental field.
+	+	----	Animal physiology	Pettenkofer's respiration apparatus; experimental stables, etc.
+	+	----	Animal and vegetable physiology; experiments in stable and field.	Experimental stables; vegetation house; farm.
----	----	+	Vegetable physiology (water culture); seed investigations; microscopical studies.	Chemical and physiological laboratories; vegetation house; garden.
+	----	----	Feeding, vegetation, and field experiments	Vegetation house; horse dynamometer; stables; experimental field.
----	----	----	Investigations of wine, tobacco, and other agricultural products.	
----	----	+	Vegetable physiology; diseases of plants	Vegetation house; experimental garden.
+	+	+	Vegetation experiments; action of fertilizers	
+	+	+	Scientific research	
+	+	+	Field experiments with fertilizers; chemical technology.	

‡ Includes a branch station at Magdeburg, with a superintendent and one assistant.

§ Proceeds of sale of dairy products.

Statistics of the agricultural experiment

Divisions of German Empire.	Location, city or town.	Date of organization.	Income.				Working force.			
			From Government.	From agricultural societies.	From analyses, etc.	Total.	Directors.	Assistants.	Secretaries.	Janitors, servants, etc.
Mecklenburg-Schwerin.	Rostock	1875	----	----	----	7,000	1	4	1	3
Saxe-Weimar	Jena	----	----	----	----	750	(*)	3	----	----
Anhalt	Coethen	1864	225	----	----	----	1	1	----	----
	Bernburg	1882	----	----	----	5,775	1	4	----	1
Alsace-Lorraine	Rufach	1874	----	----	800	3,665	1	2	----	1
Bremen	Bremen	1877	8,125	100	2,025	10,750	1	7	1	----
	Stations outside the association.									
Prussia	Berlin	----	----	----	----	37,500	2	7	----	----
	Berlin	----	----	----	----	17.750	4	7	----	----
	Breslau (Institute for Animal Chemistry of the University).†	1869	787	----	----	----	1	2	----	----
	Breslau	----	----	----	----	625	1	----	----	----
	Proskau (Royal Pomological Institute).	1873	375	----	----	----	1	1	----	----
	Proskau (Dairy Institute)	1878	2,250	100	----	----	1	1	----	----
	Arendsee	----	----	----	----	----	1	----	----	----
	Magdeburg	1885	----	----	----	----	1	3	----	----
	Göttingen (Agricultural Institute of the University).	1872	----	----	----	----	1	1	----	----
	Bremervörde	1876	----	----	----	----	1	1	----	----
	Kempen	1883	----	750	----	----	1	----	----	----
Bavaria	Munich (Royal Technical High School).	1875	1,050	----	----	----	1	1	----	----
	Munich	1874	----	----	----	----	2	7	----	----
	Weihenstephan	1866	----	----	----	----	1	3	----	----
	Bayreuth	1867		‡ 162	----	----	1	----	----	----
	Landshut	1876		‡ 25	----	----	1	1	----	----
Saxony	Dresden (Veterinary School).	1862	750	----	----	----	1	1	----	----
	Döbeln	1872	----	----	----	----	1	1	----	----
Württemberg	Hohenheim	1877	525	----	200	----	1	1	----	----
Saxe-Meiningen-Hildburghausen	Eisfeld	1872	----	----	----	----	1	----	----	----
Total	----	----	49,103	5,165	31,526	153,928	73	149	5	17

* Board of four professors.
† Transferred from Proskau in 1881.

stations of the German Empire, July, 1899—Continued.

Inspection.			Special lines of work.	Equipment.
Fertilizers.	Feeding stuffs.	Seeds.		
+	+	+	Vegetable physiology; feeding experiments.	Vegetation house; stables; experimental field.
+	+	+	Chemistry; vegetable physiology	
+	+	----	Sugar-beet culture; feeding experiments	
----	----	----	Vegetable physiology; sugar-beet culture	Vegetation house; experimental field.
+	+	+	Vegetable physiology; vine culture; inspection of foods and beverages.	
----	----	----	Moor culture	
----	----	----	Station of the Union of manufacturers of alcoholic spirits.	
----	----	----	Station for beer manufacture	
----	----	----	Animal physiology	
----	----	+	Agricultural botany; seed control.	
----	----	----	Vegetable physiology, especially diseases of fruit trees.	
----	----	----	Dairying	Laboratory; experimental dairy; collection of models, etc.
----	----	+	Seed testing	
----	----	----	----	
----	----	----	----	Laboratory and experimental field.
----	----	+	Seed control	
+	+	+	Scientific research	
----	----	----	Agricultural physics and physiology	Laboratory; experimental field.
----	----	----	Chemical station for beer brewing	Laboratory.
----	----	----	do	Chemical and bacteriological laboratories; experimental breweries; garden; fields.
----	----	----	Fertilizers; feeding stuffs; seeds; soils	
----	----	+	Seed control	
----	----	----	Animal chemistry, physiology, and pathology.	
----	----	----	Physics and chemistry of fertilizers and soils; vegetation experiments.	
----	----	----	Seed testing	
----	----	----	Chemical investigations of fertilizers, etc.	
29	27	33		

‡ Income from both government and agricultural societies.

ABSTRACTS OF BULLETINS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES FROM JULY TO DECEMBER, 1889.

PART I.

ALABAMA.

Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama.

Department of the Agricultural and Mechanical College of Alabama.

Location, Auburn. Director, J. S. Newman.

BULLETIN No. 6 (NEW SERIES), JULY, 1889.

Grasses of Alabama and their cultivation, P. H. Mell, Ph. D. (pp. 3–40), (illustrated).—This bulletin is the revised form of the pamphlet on Wild Grasses, issued by the Alabama State Department of Natural History and Geology in 1886. Accounts of grasses analyzed since the publication of the first edition are added. The illustrations consist of twenty-nine plates taken from the Annual Reports of the United States Department of Agriculture. This is intended as the first of a series of station publications on the forage plants growing wild in Alabama, which include a large proportion of the wild species found in the United States east of the Mississippi River. "Not half of these have been tested to determine their value for stock food."

The bulletin also contains directions for manuring grass lands, formulas for mixtures of grasses, hints as to economical methods in making and feeding hay, definitions of botanical terms, and directions for collecting and preserving grasses. Then follows a list of the grasses and forage plants of the State, with scientific and common names, time of blooming, and place of growth: and descriptions of thirty-eight of the more important species with analyses of green grass or hay of a considerable number, and practical suggestions as to cultivation and value. The following species are spoken of as particularly desirable for field culture or for hay in that section: Meadow oat-grass or tall oat-grass (*Arrhenatherum avenaceum*); Bermuda grass (*Cynodon dactylon*): yard-grass, crow-foot or crabgrass (*Eleusine indica*): Japan clover (*Lespedeza striata*); Texas millet (*Panicum texanum*); prolific panic grass or sprouting crabgrass (*Panicum proliferum*).

BULLETIN No. 7 (NEW SERIES), OCTOBER, 1889.

EXPERIMENTS WITH METHODS OF SETTING AND CHURNING MILK, ISAAC ROSS (pp. 3–6).—These were with the milk from three Jersey cows for six weeks. Six different methods of setting milk were used, each for one week. The record as given shows that in this case the best results as regards amount and quality of butter were obtained when the milk was set twenty-four hours in well-water, changed twice daily. Apparently, however, no allowance was made for differences in the feeding and treatment of the cows, nor for the natural variations in milk and butter yield.

EXPERIMENT IN SETTING MILK VERSUS CREAMING WITH THE DE LAVAL SEPARATOR, J. W. HART (pp. 7, 8).—Tests were made for six days with the milk of eleven Jersey cows to compare the two methods. Circumstances stated in the bulletin made the tests inconclusive. In this case, however, as in other experiments in the South, the indications were that for that region the centrifugal is more economical than the deep-setting system of creaming milk, because of the great expense attending the use of ice.

EXPERIMENTS WITH VARIETIES OF VEGETABLES, JAMES CLAYTON (pp. 9–16).—Notes are given on tests of forty-six varieties of tomatoes, twenty of potatoes, fifty-three of bush beans, and forty of English peas. Among the varieties of tomatoes, Acme, Golden Queen, and Paragon are named as very desirable. Of potatoes, Burbank, Mammoth Prolific, and Rose's New Giant, are specially recommended.

DATA FROM SOIL THERMOMETERS, P. H. MELL, PH. D. (pp. 17–19).—A record of observations for six months (January to July, 1889) with three sets of thermometers (two on a hill and one in bottom-land), placed at depths of from 3 to 96 inches.

DIRECTIONS FOR SENDING SPECIMENS OF DISEASED PLANTS AND OF INSECTS TO THE STATION, G. F. ATKINSON, PH. B. (pp. 20, 21).

BULLETIN No. 8 (NEW SERIES), NOVEMBER, 1889.

COMMERCIAL FERTILIZERS, N. T. LUPTON, LL. D. (pp. 3–15).—This contains brief statements regarding composition, formation, and deterioration of soils; composition of plants and commercial fertilizers; the sources of phosphoric acid, potash, and nitrogen; value of cotton seed as a fertilizer; commercial values of fertilizers for 1889; methods of mixing fertilizers; and the provisions of the Alabama fertilizer law. There are also the results of analyses made since April 1, 1889, in the following numbers: Complete fertilizers, 79; acid phosphates, 19; marls, 9; natural phosphates, 24; miscellaneous, 22; total, 153.

The manufacturer who sells his goods in Alabama is required by law to brand on each bag or package his guaranteed analysis of the fertilizer contained therein. To protect the farmer against fraud, an official chemist has been provided by the State whose duty it is to furnish the commissioner of agriculture a correct analysis of every sample of fertilizer sent to him by the commissioner; and every farmer in the State can obtain the services of the chemist, free of cost, to test the guarantee of the manufacturer; and if the goods do not come up to the guarantee, the law releases the purchaser from any obligation to pay for the fertilizer.

BULLETIN No. 9 (NEW SERIES), DECEMBER, 1889. (SCIENCE CONTRIBUTIONS, Vol. 1, No. 1.)

NEMATODE ROOT-GALLS, G. F. ATKINSON, PH. B. (pp. 5–54) (illustrated).—A preliminary report upon the life history and metamorphoses of a root-gall nematode, *Heterodera radicicola* (Graef), Müll., and the injuries caused by it upon the roots of various plants. This is the first number of a series of publications entitled "Science Contributions," in which it is proposed to publish reports of the more strictly scientific researches conducted at this Station. It contains a preliminary report on investigations made in the autumn of 1889 on the nature and causes of the abnormal growths on the roots of various plants, termed root-galls or root-knot. The subject is treated under the following topics: Introductory; external characteristics of the disease; microscopical characteristics; general characteristics of the mature female cyst; development and metamorphoses; structural characteristics of the diseased roots; treatment; list of thirty-six kinds of plants affected; list of thirty-six American and foreign works consulted; and explanations of plates.

The bulletin is illustrated with six plates containing numerous diagrams of the worms in different stages and of the diseased portions of various plants. There is also a considerable number of references to European and American publications on these and kindred topics.

Root-galls have been found by the author on thirty-six different kinds of plants in the vicinity of the Station. Among those on which they were observed most numerously are potatoes, tomatoes, cow-peas, sunflowers, water-melons, cabbages, ruta-bagas, parsnips, and salsify. "Upon examination with the microscope the enlargements proved to be the galls produced by the presence of a nematode worm, *Heterodera radicicola*, Müll. (*Anguillula radicicola*, Graef, *Anguillula arenaria*, N., *ex parte*)."

Brief recapitulation of the life history.—Egg: The oblong, bean-shaped egg, .08^{mm} to .10^{mm} long, developed in the anterior part of the ovaries, after fertilization, inclosed in a double-walled membrane, undergoes partial or complete segmentation while yet within the uterus. From the beginning of segmentation to the fully developed larva five to seven days are required. The thread-like larva is coiled three or four times within the egg membrane. *Larva:* At the time of hatching or soon thereafter it molts for the first time. It is "thread-like," blunt at the head end, and narrowly pointed at the tail end, .3^{mm} to .4^{mm} long. In the head end can be easily noted the exsertile spear and the long tortuous channel of the anterior part of the œsophagus extending to a prominent ovoid or ellipsoid muscular bulb, the middle part of the œsophagus. From this point the lumen of the alimentary canal can be seen extending down through the middle of the body, in which is a matrix that develops many fat globules; the anus is situated at the beginning of the hyaline portion of the tail end. The larva now leaves the cyst cavity and enters a fresh root or a different place in the same root. It wanders for a time, when it comes to rest, molts a second time and then being fixed enlarges, or "swells up" into a cyst with a flask-like body, the head projecting at one end and the slender pointed tail at the other. At this time prominent sexual transformations take place. *Male:* The male molts again (third time) leaving the outer wall of the cyst intact, while the body of the male elongates, narrows, and becomes coiled three or four times within the cyst. While this change is going on the male molts again (fourth time). It is now from 1^{mm} to 1.5^{mm} long, anguillula-like, blunt at each end, slightly curved at the caudal end where are two curved spicules. In the middle line of the body runs the alimentary canal, in the posterior half of the body are the paired testes, which are united into a common duct near the caudal end and at the cloaca this unites with the intestine. On each side within the body is a muscular cord extending the entire length of the worm. *Female:* The female does not molt again, but continues to enlarge enormously until it is gourd-shaped, and the paired generative organs, opening by a common passage at the vulva in the posterior part of the body, form long tubes which lie coiled in the body of the cyst, free at their anterior end. As the embryos are developing the body of the cyst breaks up into an amorphic, gelatinous mass in which the young larvæ and eggs are found floating within the cyst cavity. Length of life cycle, one month.

Attention is called to the very close resemblance between *H. radicicola* and *H. schachtii.* The author seems to be doubtful whether they are really distinct species, and desires to make further studies before deciding whether his own observations include more than one species. He also remarks on the wide distribution of the genus *Heterodera* in various parts of the world, and is inclined to believe that the nematodes may grow much further north than has been supposed.

The external form of the gall is to a great extent dependent upon the number of worms and their distribution in the tissues of the roots, as well as upon some specific peculiarities in the growth of the roots or habit of branching. If the worms are numerous and the attack is made pretty regularly in a peripheral plane at a particular point in the root, the gall will be symmetrical, and either short and ovoid or elongate and fusiform, according to the extent of their distribution along the axis of the root at that point. If fewer worms attack at a given point the gall is more likely to be lateral, owing to the less certainty of an even peripheral infection. Often, however, lateral galls may be so near as to unite into one, when the appearance is that of a very irregular and knotty gall, the enlargements passing by abrupt changes on different sides of the root.

The similarities and differences of root-galls, potato scab, and "club-foot" of cabbage are pointed out, and the root-galls are also distinguished from the "tubercles" found on the roots of leguminous plants, which seem to have such an important connection with the acquisition of nitrogen from the air by these plants.

Rotation of crops and clean cultivation are suggested as among the means for eradicating the nematodes or checking their spread, but the author wisely thinks that further investigations are needed before positive remedies can be recommended.

Canebrake Agricultural Experiment Station.

Department of Agricultural and Mechanical College of Alabama.

Location, Uniontown. Director, J. S. Newman.

BULLETIN No. 4, APRIL, 1889.

EXPERIMENTS WITH COTTON, W. H. NEWMAN, M. S. (pp. 3–7).—A series of experiments was conducted to observe the effects of manures and different methods of cultivation. The results, which are exhibited in tabular form, are conflicting. "It will require a series of experiments conducted sufficiently long to secure average results before reliable conclusions can be drawn."

METEOROLOGICAL OBSERVATIONS (p. 8).—A summary of observations for January, February, and March, 1889.

BULLETIN No. 5, JULY, 1889.

EXPERIMENTS WITH FERTILIZERS ON OATS, W. H. NEWMAN, M. S. (pp. 3–7).—The experiments were conducted on "what is known in the Canebrake as black slough bottom," drained and undrained, to observe the effects of fertilizers and of drainage. In the first series, cotton-seed meal, raw phosphate, and cotton-seed hull ash; and in the second, cotton-seed meal, green cotton seed, stable manure, and a commercial fertilizer were used singly or in combination. The undrained land, lying lower down the slough, is naturally more fertile than the drained. The actual yields, as shown by careful weighing and measurements, were in a number of cases less with the fertilizers than without them. In other cases there was an apparent increase with the use of each of the fertilizing materials. There was no duplication of plats on either the drained or the undrained land. The data, therefore, do not show in how far the difference of yield was due to unevenness of soil or other causes, including drought.

Experiments were also made upon different methods of seeding and different varieties.

EXPERIMENTS WITH WHEAT, W. H. NEWMAN, M. S. (pp. 7–10).—These were made with one variety on "shell ridge" land and with different varieties on slough bottom, and were somewhat similar in plan and results to those with oats. It is noticeable that the yield with cotton-seed-hull ashes and cotton-seed meal was less than with cotton and meal alone on both the drained and the undrained land.

METEOROLOGICAL REPORT (pp. 11–14).—The temperature and rainfall from October 1, 1888, to June 30, 1889, are reported. Brief observations were made upon the rain-fall on 3 acres of drained land, and the outflow from the drains. October 22 to 25, 3.7 inches of rain fell, of which it was roughly estimated that 68 per cent ran out of the drains between October 24 and October 30. April 13 to 15, 3.42 inches of rain fell, of which 23 per cent seems to have been withdrawn through the drain. The promptness with which drains removed surplus water from such a tenacious soil is worthy of notice.

BULLETIN No. 6, OCTOBER, 1889.

VEGETABLES (pp. 3-13).—*Potatoes.*—(1) Notes on the yield of ten varieties. (2) A brief account of an experiment with cotton-seed meal and hull ashes, kainit, and raw phosphate, applied singly and in combination, and compared with stable manure, on "black slough" bottom land. None of the fertilized plats produced more than the unmanured plats, except those where cotton-seed meal and kainit, and cotton-seed meal and hull ashes with raw phosphate were used. (3) Deep and shallow planting, bedding, and level culture were compared without conclusive results. (4) Notes on the keeping qualities of ten varieties.

Notes are also given on twelve varieties of peas, five of radishes, ten of tomatoes, six of cabbages, and seven of cantaloupes.

GRAPES (pp. 13-16).—Notes on eleven varieties. The methods of cultivation and pruning and the use of paper bags to protect the bunches of grapes are also described. The year's experience is summarized in the statements that:

"(1) The grape grows and fruits well on 'Red Prairie' land.

"(2) The varieties of black grapes rot less than the white.

"(3) Sacking the white grapes (except Niagara) and Delaware (red) does not pay.

"(4) The Concord, Ives, Norton's Virginia, Niagara, and Hartford will pay for planting in the prairie for table use, and are benefited by being sacked."

METEOROLOGICAL REPORT (pp. 17-23).—Tabular summaries and explanatory notes of observations made from August 1, 1888, to August 1, 1889, on the temperature of the air, precipitation, cloudiness, and wind; and on the temperature of drained and undrained land as recorded by soil thermometers placed at seven different depths from 1 to 36 inches.

ARKANSAS.

Arkansas Agricultural Experiment Station.

Department of Arkansas Industrial University.

Location, Fayetteville. Director, A. E. Menke, D. Sc.

BULLETIN No. 11, SEPTEMBER, 1889.

STRAWBERRIES (pp. 3-9).—This article contains notes on forty varieties planted in 1888 on the Station grounds at Fayetteville; twenty-three varieties planted at the same place in 1889; thirty-six varieties grown at the branch Station at Pine Bluff in 1888 (?), and nineteen varieties planted in 1889.

WHEAT (pp. 9-10).—Twenty-two varieties were tested. As the result of two years' observations, Fultz and Michigan Amber are recommended as "varieties well suited to this latitude."

Two years' experiments with fertilizers on wheat led the Station to recommend 250 pounds of cotton-seed meal to the acre as on the whole the most economical fertilizer for this section. Further details of the experiments with wheat will be given in the annual report of the Station for 1889.

OATS (p. 11).—Black Russian is recommended as a good variety of winter oats for this latitude. One season's experiments with nitrate of soda, acid phosphate, floats, kainit, and cotton-seed meal, singly and in combination, indicate that there is little profit in their use on this land "which had been cultivated but little." It is anticipated that "similar experiments on worn lands in the center of the State" may give different results.

CALIFORNIA.

Agricultural Experiment Station of the University of California.

Department of the University of California.

Location, Berkeley. Director, E. W. Hilgard, Ph. D., LL. D.

BULLETIN No. 83, NOVEMBER 1, 1889.

THE RISE OF THE ALKALI IN THE SAN JOAQUIN VALLEY, E. W. HILGARD, PH. D. (pp. 1-4).—"The rapid increase of population in the San Joaquin Valley, and the frequency with which inquiries relative to the nature and treatment of 'alkali' come to this Station from that section, as well as other portions of the State, render it expedient to give a summary of the main points in this problem in this bulletin. A more elaborate treatise on the same subject, originally published in the annual report for 1880, has been reprinted and can still be sent to those desiring more detailed information."

In the San Joaquin Valley (particularly in its upper portions) there is during the dry season a "blooming out" of soluble salts on the surface of the ground, due to the decomposition of minerals in the soil into salts, which in dry times are not washed out, but rise to the surface during evaporation of the soil moisture. These alkali salts vary greatly in composition. The three principal ingredients are common salt (chloride of sodium), Glauber's salt (sulphate of soda), and sal-soda (carbonate of soda). When carbonate of soda predominates a black deposit is made at the surface, popularly called "black alkali," as distinguished from the "white alkali," in which the two other ingredients are chiefly found. The "black alkali," the color of which is due to the solution of humus by the carbonate of soda, is by far the most pernicious. It may, however, be converted into the "white" "by dressings of gypsum or land plaster, 200 to 500 pounds per acre, and the relief thus afforded is in very many cases all that is needed to insure profitable cultivation." Along with the harmful mineral substances there are always present in these soils others, such as potash, phosphates, and nitrates, which insure great fertility to these lands under proper treatment. It has been found to be worse than useless to attempt to remove the surplus salts by putting water on the land without insuring drainage, for this causes the alkali to rise from great depths, and thus increases rather than diminishes the amount of deleterious substances in the soil. On the other hand, "*under-drainage is the general and absolute correction for alkali*." Under-drainage is expensive, "but the time is not far distant when in California, as well as in Illinois and in the East generally, the laying of under-drains will be considered an excellent investment on any land as valuable as all irrigated land is likely to be, and when that day comes 'alkali' will be at an end on irrigated lands in this State." Until that time comes "the chief measure toward the prevention of the rise of the salts to the surface is whatever tends to prevent evaporation from the land surface, and therefore particularly the maintenance of deep and thorough tilth and the avoidance of the formation of any surface crusts." The bulletin also contains a table showing the composition of the alkali salts in different parts of the San Joaquin Valley (Fresno, Tulare, and Kern Counties).

BULLETIN No. 84, DECEMBER 5, 1889.

DISTRIBUTION OF SEEDS AND PLANTS, E. J. WICKSON, M. A. (pp. 1-4).—Plants and seeds were distributed from this Station during the winter of 1889 in greater amounts and more widely than in any previous year. The number of applications received was 1,060, of which 994 were filled, wholly or in part. Every county of California was reached except two small mountain counties, and packages were sent to nearly one-half of the post-offices in the State. Recipients pay for packing, postage, and express ($268 in all for this season), and are expected to report results obtained with the seeds and plants sent. The Station can not undertake to distribute seeds and plants to residents of other States, but can make some exchanges with other experiment stations.

COLORADO.

Agricultural Experiment Station of Colorado.

Department of the State Agricultural College.

Location, Fort Collins. Director, Charles L. Ingersoll, M. S.

BULLETIN No. 8, JULY, 1889.

ALFALFA: ITS GROWTH, COMPOSITION, DIGESTIBILITY, ETC. (pp. 3-24).—This includes an account of the habits of growth of alfalfa and of the methods of culture, curing, and irrigation of this plant. The parasitic dodder (*Cuscuta*) is also described, and farmers are urged to prevent its introduction with alfalfa by taking care to purchase pure seed. Analyses of alfalfa cut at different periods of growth are given and compared with similar analyses of other plants. Feeding experiments regarding the digestibility of alfalfa were made with two steers and the results compared with those of similar experiments in the use of other feeding stuffs. The advantages of alfalfa for Colorado and the whole arid region are thus summarized:

"(1) It is easy to secure a fine stand of plants, if the soil be put in proper condition.

"(2) Its staying qualities are good, as the oldest fields show no diminution in growth or yield: neither does it kill by winter exposure, if given the least care and irrigation at the proper time.

"(3) The quantity produced by the many cuttings makes it much more valuable than the other clovers or grasses.

"(4) It is as digestible as clover hay, constituent by constituent.

"(5) Its chemical composition shows that it is a rich, strong food, when properly cured.

"(6) It is relished by all farm animals and is an excellent flesh and milk producer.

"In general, it has about all the good qualities of a forage plant, with very few poor ones."

BULLETIN No. 9, OCTOBER, 1889.

SOILS AND ALKALI. D. O'BRINE, D. SC. (pp. 3–27).—This article, which is rather popular in form and substantially correct in its practical conclusions, though not entirely accurate in its scientific details, contains general statements regarding the origin and physical and chemical properties of soils: analyses of eleven samples of Colorado soils: a discussion of the "aklali soils of Colorado;" analyses of samples of alkali from a farm near Fort Collins, and of samples of river, seepage, well, reservoir, and lake waters: and inferences regarding waters for irrigation. The danger of injuring the soil by irrigating with water highly charged with alkaline salts is emphasized.

CONNECTICUT.

The Connecticut Agricultural Experiment Station.

Location, New Haven. Director, Samuel W. Johnson, M. A.

BULLETIN No. 100, SEPTEMBER, 1889.

SYLVANIT, UNLEACHED WOOD ASHES, AND COMMERCIAL FERTILIZERS (pp. 1–28).—This bulletin contains: (1) An analysis of sylvanit, a German potash salt; (2) analyses of unleached wood ashes, with data regarding their average composition and notes on their agricultural use; (3) analyses and valuations of 76 commercial mixed fertilizers—nitrogenous superphosphates, guanos, and special manures—from about 580 samples collected by the Station agents, in April and May, 1889, from the stocks of dealers in 127 towns and villages in different parts of the State.

The following brief and clear summary is taken from the bulletin:

"1. Sylvanit is a potash salt containing more potash than kainit, and consists of sulphates and muriates of potash and soda, the muriates preponderating, so that it can not fairly be called a 'sulphate of potash.'

"2. (*a*) Some of the samples of ashes analyzed this year were notably deficient in potash.

"(*b*) Ashes from household fires in New England as a rule contain more potash and phosphoric acid than Canadian or Western ashes.

"(*c*) A large part of ashes, leached as well as unleached, consists of carbonate of lime, which may benefit land in three ways:

"First. It binds loose soils and makes them hold moisture, and on the other hand makes clay soils less stiff.

"Second. It corrects 'sourness' in the soil, caused either by soluble iron salts or mineral acids.

"Third. It favors nitrification.

"(*d*) Hence the value of ashes never wholly, nor always, chiefly consists in the plant food which they contain.

"(*e*) It is possible that a heavy application of unleached ashes might injure a heavy clay soil by reason of the alkali in them.

"3. (*a*) The analyses of seventy-six mixed commercial fertilizers are given in this bulletin. In twenty-seven of them the percentage of one ingredient is below the minimum quantity guaranteed by the maker. In twelve others two ingredients are deficient and in five others, all three—nitrogen, phosphoric acid, and potash—are deficient as compared with the guarantee.

"(*b*) The average percentage difference between cost and valuation this year has been 19.1 for superphosphates and guanos and 13.4 for special manures, which is lower than in any year since 1884."

Storrs School Agricultural Experiment Station.

Connected with Storrs Agricultural School.

Location, Storrs. Director, W. O. Atwater, Ph. D.

BULLETIN No. 4, JULY, 1889.

METEOROLOGICAL OBSERVATIONS, E. A. BAILEY (p. 1).—Summary of observations from January 1 to June 30, 1889.

BACTERIA IN MILK AND ITS PRODUCTS, H. W. CONN, PH. D. (pp. 2–12).—This is a brief report on investigations made in 1888 and 1889, including a condensed statement of the methods used, and accompanied by general explanations. The following summary is printed in italics in the bulletin:

"(1) Bacteria, or microbes, as they are often called, abound in air, water, and soil, in animal and vegetable substances, and in living plants and animals. They are extremely minute, and multiply with wonderful rapidity wherever the circumstances are favorable. Cold hinders their development. When heated long enough at the temperature of boiling water, they are killed, but their spores, which correspond to seeds, will endure even this temperature for some time, though higher heat kills them speedily.

"(2) Bacteria grow with the greatest readiness in milk and cream. Hence they collect in milk and cream exposed to the air, and multiply rapidly. In developing they cause the milk to sour and curdle and induce other changes in it. They also favor the ripening of cream.

"(3) Vessels in which milk and cream are to be kept are a great source of contamination by bacteria. The latter gather upon the sides and in the joints, and develop in the minute portions of milk, grease, or other matters from which it is difficult to free the walls of the vessels completely by washing.

"(4) A large number of different species of bacteria are found in milk and cream. Different species have different effects. Most of them sour and curdle milk at some temperature. A few induce changes that render milk alkaline without the formation of curd. When a curd is formed it differs in character with different species of bacteria. The souring of milk is more complex than has been supposed: and while without much doubt souring always depends upon the action of bacteria, any one of a number of species, or several combined, may be the cause.

"(5) The longer a specimen of milk has been exposed to the action of bacteria, other things being equal, the greater will be the number of bacteria present. Hence it follows that cream will usually contain a very large number. The presence of these organisms, so far from being injurious, is of a positive advantage to the butter maker, since it is by their action that cream is 'ripened.'

"(6) The ripening of cream appears to be even more complex than the souring of milk. While the ripening of cream is undoubtedly dependent upon the presence of bacteria, it is doubtful whether one species can produce what is known as ripened cream. Dairymen let their cream ripen before churning because their experience implies that the butter separates ('comes') more readily, keeps better, and is of better flavor. A plausible explanation is that the bacteria break up the albuminous matter which encloses the particles of butter fat, so that the butter is more readily separated from it, and when made contains less of it. Since this albuminous matter affords support for bacteria, which cause butter to become rancid, it is natural to suppose that butter will keep the better the less it contains.

"(7) Two important points in the handling of milk and cream are brought out by these considerations:

"First. The importance of keeping milk, so far as possible, free from bacteria and at a low temperature, in order that the cream may all separate before the milk sours.

"Second. The advantage of keeping cream under circumstances favorable to the growth of the bacteria that induce ripening.

"(8) In brief, vessels in which milk is to be kept for creaming or for transport should be most carefully cleansed before the milk is put in them. As cold retards, and heat, up to certain limits, favors the growth of bacteria, the advantage of keeping milk cold and cream warm is easily explained."

BULLETIN No. 5, OCTOBER, 1889.

ATMOSPHERIC NITROGEN AS PLANT FOOD. W. O. ATWATER, PH. D., AND C. D. WOODS, B. S. (pp. 1–18).—This is a condensed report of an investigation in continuation of one begun some years ago by Professor Atwater at Wesleyan University, where the chemical work of the Station is done. Those experiments, of which results were published in 1882–85, showed that leguminous plants (peas) acquired large quantities of nitrogen from the air and implied that free nitrogen was probably thus assimilated. These conclusions have since been confirmed by other experiments, especially those of Hellriegel, who pointed out the connection of bacteria and root tubercles with the gain of nitrogen. The present experiments were for a further study of the acquisition of atmospheric nitrogen by different plants and the relation of root tubercles thereto. Details are reserved for the annual report of the Station for 1889. Eighty-nine experiments, divided into five series, were performed with peas, alfalfa and oats.

The plants were grown in glass jars containing sand, purified by washing and igniting. Nutritive solutions, either free from or containing known quantities of combined nitrogen in the form of nitrate of potash or lime, were applied to the sand. The amounts of nitrogen supplied in nutritive solutions and seed were compared with the amounts found at the end of the experiments in residual solutions and plants. The difference between these two amounts must show the loss or gain in nitrogen. A gain must represent the nitrogen acquired from the air in excess of any lost either from organic matter of seed or plant or from nitrate of the food.

The results of these and similar experiments by these authors and others are thus summarized:

"(1) Peas, alfalfa, serradella, lupine, clover in all probability, and apparently leguminous plants in general, are able to acquire large quantities of nitrogen from the air during their period of growth.

"(2) There is scarcely room to doubt that the free nitrogen of the air is thus acquired by plants.

"(3) That there is a connection between root tubercles and this acquisition of nitrogen is clearly demonstrated. What this connection is, what are the relations of micro-organisms to the root tubercles, and the acquisition of nitrogen, and in general how the nitrogen is obtained, are questions still to be solved.

"(4) The cereals with which experiments have been completed have not manifested this power of acquiring nitrogen, nor do they have such tubercles as are formed on the roots of legumes.

"(5) In the experiments here reported the addition of soil infusions did not seem necessary for the production of root tubercles. A plausible supposition is that the micro-organisms or their spores were floating in the air and were deposited in the pots in which the plants grew.

"(6) As a rule, the greater the abundance of root tubercles in these experiments, the larger and more vigorous were the plants and the greater was the gain of nitrogen from the air.

"(7) In a number of these experiments, as in similar ones previously reported, there was a loss of nitrogen instead of gain. The loss occurred where there were no root tubercles; it was especially large with oat plants, and largest where they had the most nitrogen at their disposal in the form of nitrates. As the gain of nitrogen by the legumes helps to explain why they act as 'renovating crops,' the loss in the case of the oats suggests a possible reason why they should appear to be an exhaustive crop.

"*Practical inferences.*—The ability of legumes to gather nitrogen from the air helps to explain the usefulness of clover, alfalfa, peas, beans, vetches, and cowpeas as renovating crops, and enforces the importance of using these crops to restore fertility to exhausted soils. The judicious use of mineral fertilizers (containing phosphoric acid, potash, and lime) will enable the farmer to grow crops of legumes, which after being fed to his stock will, with proper care to collect and preserve all manure, both liquid and solid, enable him to return a 'complete fertilizer' in the shape of barnyard manure to his land. A further advantage of growing these crops is that the nitrogenous material, protein, which they contain in such great abundance is especially valuable for fodder."

METEOROLOGICAL OBSERVATIONS, E. A. BAILEY (p. 19).—Summary of observations from July 1 to September 30, 1889.

DELAWARE.

The Delaware College Agricultural Experiment Station.

Department of Delaware College.

Location, Newark. Director, Arthur T. Neale, Ph. D.

BULLETIN No. 6, OCTOBER, 1889.

SUMMARY OF THE STATION'S EXPERIMENTS ON THE BLACK ROT OF GRAPES, A. T. NEALE, PH. D. (pp. 3-6).—Experiments with Bordeaux mixture for this disease on the vineyard of Mr. Anthony, of Smyrna, Del., resulted in a saving estimated at $65.62 per acre. The results of experiments in Dr. Black's vineyard in Newcastle County, while agreeing in the main with those at Smyrna, brought out the additional fact that the Bordeaux mixture may sometimes be used without appreciable effect. It should be observed, however, that in the former case the mixture contained 1 pound of sulphate of copper to eight vines; in the latter, the same amount to four vines. It was shown by experiments at Smyrna that grapes spotted with a greenish-blue crust of Bordeaux mixture could be cleaned with a weak solution of vinegar (2 quarts of cider vinegar to 10 gallons of water) at an average expense of 6 cents per 100 pounds of grapes. For this purpose Mr. Anthony used the following apparatus: (1) Circular wire baskets 20 inches in diameter and 11 inches deep; (2) three ordinary tubs, one for the vinegar solution and the others for water; (3) wire frames or shelves from a fruit evaporator. The baskets loaded with grapes were soaked for a few minutes in the vinegar solution, dipped in each tub of water, and exposed a short time to dry on the wire frames.

Tests made by the chemist of the Station indicated that grapes which have been sprayed with the Bordeaux mixture did not have enough adhering copper salts to injure health when eaten.

THE BLACK ROT OF THE GRAPE CONTROLLED BY THE BORDEAUX MIXTURE, F. D. CHESTER, M. S. (pp. 7–17).—A detailed account of the experiment in Mr. Anthony's vineyard above referred to.

BOTANICAL DESCRIPTION OF THE BLACK ROT OF THE GRAPE, F. D. CHESTER, M. S. (pp. 18–28).—A compiled account of the fungus causing this disease.

NOTES ON THE BLACK ROT OF THE GRAPE, M. H. BECKWITH (pp. 28–32).—An account of experiments in Dr. Black's vineyard (above referred to), with sulphate of copper, sulphate of potassium, Eau Celeste, and Bordeaux mixture on Champion and Concord grapes. The Bordeaux mixture produced the best results on the Concords, but failed to protect the Champions. The experiments will be continued.

BULLETIN No 7, DECEMBER, 1889.

STOCK FEEDING, A. T. NEALE, PH. D. (pp. 3–24).—1. *Utilization of clover hay and cornstalks.*—It is urged that under certain conditions live stock should be kept upon a farm, even if the market prices of milk and meat admit of no direct visible profits. Such conditions exist—

(1) When crude farm products, clover hay, etc., command at wholesale prices lower than their intrinsic values.

(2) When large quantities of unsalable cornstalks, etc., are on hand, which could be used as food for milch cows, sheep, etc. This is supported by calculations based upon the composition of clover hay and of cornstalks, the quantities and values of their nutritive ingredients for feeding and of their manurial ingredients for fertilizers, and the estimated cash value of these feeding stuffs if used in making milk to sell at creameries.

2. *Explanation of terms used in the analysis of feeding stuffs.*—The meaning of the terms crude protein, carbohydrates, fiber, etc., is explained and illustrated by a woodcut, in colors, of a section of a grain of wheat, as viewed under the microscope.

3. *The chemical control of concentrated feeds.*—In 1889 twelve inspectors, selected from the farmers in different sections of the State,

collected 49 samples of feeding stuffs, including wheat bran and middlings, ship stuff, cotton-seed meal, corn meal, oats, and cob meal. These were analyzed by C. L. Penny, M. A., chemist of the Station, who gives the details in a number of tables, together with the averages of these analyses as compared with the standards for these feeding stuffs prepared by Dr. Jenkins, of the Connecticut Station. This comparison was very favorable to the Delaware samples.

4. *The wholesale prices per pound of protein and carbohydrates in concentrated feeds in Delaware.*—Comparison of the market price and the actual value as determined by chemical analyses was made for a number of feeding stuffs by "the method of the least squares." The average wholesale prices of the nutritive ingredients in bran, middlings, cotton-seed meal, cob meal, corn meal, and oats, as sold in Delaware leaving digestibility and manurial value out of account) are for crude fat, 4.45 cents; protein, 1.23 cents; and carbohydrates, 0.52 cent per pound. "These rates represent in the first place the actual cost of protein, fat, etc., in a mixture made of equal weights of each of the six feeds named above; in the second place they represent the only figures, which also give each and every one of the above feeds that valuation which is the closest possible approximation to its actual market price." The utility of these calculations is illustrated by the examples of their practical application given in this bulletin: (1) By the use of the calculated wholesale cost per pound of food it was shown that the present price of clover hay is 50 per cent below its intrinsic feeding value in comparison with bran, cotton-seed meal, etc. (2) By the use of the same figures it was found possible to arrange the concentrated feeds common in this State, according to their expensiveness for feeding purposes, thus giving those stockmen who know what they require an opportunity to select the material most reasonable in price.

FLORIDA.

Agricultural Experiment Station of Florida.

Department of Florida State Agricultural and Mechanical College.

Location, Lake City. Director, Rev. J. P. De Pass.

BULLETIN No. 6, JULY, 1889.

Trifolium incarnatum (crimson clover) and Poa arachnifera (Texas blue grass), J. C. Neal, Ph. D. (pp. 3, 4).—Notes on these two plants, which are being experimented with in the hope of finding a plant suitable for pasturage or silage in this State. A number of forage plants have already been experimented with at the Station, but thus far none has been found which makes a satisfactory growth in this climate.

Chemical analyses, J. M. Pickell, Ph. D., and J. J. Earle, B. A. (pp. 5–18).—This includes analyses of ten samples of water from different parts of Florida, four of gypsum, four of ashes, three of muck, one of bat guano, and six of soils, with explanations of the analyses.

PLAN OF CHEMICAL LABORATORY AND STATION HEADQUARTERS (pp. 19, 20).

BULLETIN No. 7, OCTOBER, 1889.

CORN EXPERIMENT (pp. 3–5).—An account of a field experiment with different fertilizers on corn. The indications are that the soil was so uneven that specific inferences are not warranted.

CUCUMBERS (p. 5).—A brief account of experiments in raising cucumbers in a cold frame.

CONSTITUENT OF MUCK, J. M. PICKELL, PH. D. (pp. 6–15).—To obtain answers to numerous inquiries about the fertilizing value of muck analyses were made of fifteen samples from various places and the results compared with those of analyses of barn-yard manure, cotton-seed meal, and a "standard commercial fertilizer." The inferences are that the muck is very variable in quality, but that if properly composted it will often produce effects similar to those of barn-yard manure. The value in particular instances can be learned only by actual trial.

GENERAL CHARACTERISTICS OF MUCK, J. J. EARLE, B. A. (pp. 15, 16).—A brief explanation of the reasons for composting muck before applying it to the soil.

MUCK COMPOSTING, J. C. NEAL, PH. D. (pp. 16–19).—"In all parts of Florida the heavy rains sweep the constantly decaying vegetation into shallow depressions, edges of ponds and sinks, almost free from sand or clay, there to form great bay heads and muck beds, only needing careful development to become of immense value to our farming interests." With a little expense and trouble the muck in many of these beds can be composted so as to be but slightly inferior to good stable manure. Directions for doing this are given in this bulletin together with eleven formulas for composts.

GEORGIA.

Georgia Agricultural Experiment Station.

Department of State College of Agriculture and Mechanic Arts, University of Georgia.

Location, Griffin (Experiment P. O.). Director, R. J. Redding.

BULLETIN No. 4, JULY, 1889.

ANALYSES OF CATTLE FOODS, C. M. STRAHAN, M. E. (pp. 64–71).—Chemical analyses of samples of hay, wheat bran, cotton-seed meal, cow-pea vines, and sweet-potato vines, with popular explanations of each analysis.

BULLETIN No. 5, OCTOBER, 1889.

REORGANIZATION (pp. 75–80).—An account of the transfer and reorganization of the Station under an act of the State legislature approved December 29, 1888. The chemical work of the Station is done by special contract at the University of Georgia; but if the present plans are carried out it will be removed to Griffin as soon as laboratories can be prepared. The connection of the station with the University is constructively preserved by allowing that institution a minority representation in the governing board. The Station farm "comprises 130 acres of gently rolling red and gray soil, the latter predominating, underlaid by strong, red clay. It is a typical middle Georgia farm, rather below than above the average in fertility."

ILLINOIS.

Agricultural Experiment Station of the University of Illinois.

Department of the University of Illinois.

Location, Champaign. Director, Selim H. Peabody, Ph. D., LL. D.

BULLETIN No. 6, AUGUST, 1889.

A BACTERIAL DISEASE OF CORN, T. J. BURRILL, PH. D. (pp. 165–175).—The following statements are taken from the description of the disease as given in the bulletin. Young diseased plants, "besides being smaller than healthy ones, are uniformly yellowish in color, the lowest leaves showing worst." In several cases at least one-half the roots—always the lowest—are injured and usually dead. The bottom part of the stalk is likewise affected, brownish spots appearing on its surface. "Sometimes masses of semitransparent, rather firm, gelatinous material are found upon these external corrosions." After midsummer the leaf-sheaths become spotted, especially on their inner side, and are more or less smeared with the gelatinous substance spread in a thin coat or layer. "Finally the ears are, at least occasionally, affected. Externally the appearance of the outer husks is like that of the diseased leaf-sheaths. * * * Internally, in the worst stage, the whole ear is reduced to a moist state of corruption, though not ill-scented."

The disease was first investigated by the author in 1882. It was then supposed to be due to chinch-bugs, which, however, together with the gelatinous substance on the leaf-sheaths, were found to be infested with bacteria. In 1887 the bacteria were identified on diseased corn stalks which had not been attacked by chinch-bugs; but, as inoculations made in healthy corn failed, the facts were not published. In 1888 bacteria were again found to be present in diseased stalks. Early in 1889 attention was once more called to the matter by Dr. Billings, as recorded in the bulletins of the Nebraska Station.* In August of that year "cultures and inoculations upon growing corn" were undertaken by the author, "and this time with unmistakable results. The bacteria, in pure cultures, were applied to the inner surface of the leaf-sheaths, without puncture, and the watery-brown spots appeared in four days, while the organisms multiplied enormously in numbers and were taken still pure—in favorable cases—in considerable quantity from the affected surfaces." Rabbits were also inoculated, but without positive results. "These tests are too few and too recent to be of much import here; but they do serve to show that the 'germ,' if the same as that in the experiments of Dr. Billings, has not now the virulence that his had either with him or myself. The identity of the two is therefore still to be proved."

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* See page 124 of Experiment Station Record, Vol. I, No. 3.

The bacteria are described in considerable detail and illustrated with a photo-engraving. The author states that "we know too little of the disease to be able to suggest a remedy."

BULLETIN No. 7, NOVEMBER, 1889.

THE BIOLOGY OF SILAGE, T. J. BURRILL, PH. D. (pp. 177–194).—The object of the investigation was to gain new information concerning the changes in silage due to fermentation and the conditions under which the various processes of fermentation take place. The nature of the yeasts, bacteria, and other ferments is briefly explained. The recent progress in the study of fermentation is discussed, and attention is called to the fact that very little has yet been done in the study of the changes in silage, though in other arts, notably in beer brewing and wine making, such studies have rendered vital service.

The investigations were begun in September, 1888, and included observations on silage from two silos on the University farms at successive intervals, and on well-preserved corn silage of 1888 from other silos. Experiments with silage from wheat, corn, mixed clover and timothy grass, in barrels, a wooden box, and stone jars are also described. Culture experiments were made by modern bacteriological methods. In connection with the microscopical and biological observations, chemical analyses were made by A. G. Manns, Ph. D., station chemist, and the methods and results stated by him in this bulletin.

The details of the experiments are not given, but the results obtained are stated and discussed at length. Though regarded by the author as largely negative and tentative, they are of decided interest and value. The following summary is condensed from the bulletin:

Fermentation in the silo and variability of silage.—The fermentation of silage is exceedingly complex and is influenced by manifold conditions. The organisms which cause the fermentations and the changes they produce are of widely different characters. The chemical compounds which undergo change, such as sugar, starch, cellulose, and various nitrogenous substances are numerous and diverse. The corn or other substances used for silage vary in maturity, in chemical composition, and in amount of moisture. The materials may be put in slowly or rapidly and packed more or less closely, and the air may be more or less completely excluded at the beginning and later. The temperature may be high or low. Indeed, the differences in the original material, the conditions of weather, the construction of the silo, the treatment and the ferments concerned make silage a very variable product and great care and much knowledge is needed to secure uniformly good silage.

Kinds of ferments.—The kinds of ferments which cause changes in the silo are numerous and as yet not sufficiently understood. They include (1) yeasts, which cause alcoholic and other fermentations; (2) bacteria, which cause the formation of acids and the heating in the silo and appear to aid in the destructive changes, notably the semiputrid decomposition, accompanied by bad odors, which so often occurs in old silage; (3) molds, which also cause putrefaction.

Alcoholic fermentation in silage—Yeasts.—It is doubtful if alcohol occurs in silage. If it does it is not ethyl alcohol—the compound to which in common usage the name alcohol is applied—but butyl alcohol or some allied form, and the fermentation which it produces is due not to yeast but to bacteria. Yeast is at no time found in the silo as a producer of alcohol. The species which does occur, often in considerable quantity, is not the familiar baker's or brewer's yeast, but another species, the *Saccharomyces mycoderma*, Rees, or *Mycoderma vini* of Pasteur. This does not produce alcohol, except to a limited extent under special conditions not known to exist in the silo. It is therefore not true, as has been claimed, that the so-called "sweet silage" is the result of an alcoholic fermentation.

Hot silage.—The hot fermentation which often takes place soon after the silo is filled is not explained fully by the facts at hand and demands much study. It is not due to yeast. The yeasts can not retain their activity at anything like the temperature attained, which reaches 60° C. (140° F.) or higher. Above 30° C. yeast loses its power of growth and development in an accelerating ratio as the heat increases. The high temperature seems to be due to two or more species of bacteria (rod-like bacilli) similar to those which appear to cause butyric and like forms of fermentation. At least two species were found. They thrive in newly filled silos at temperatures from 60° to 70° C. These organisms are found in hot silage and in equally hot manure piles. They are anærobic, that is to say, they do not need free oxygen, or, in other words, they do not require air for life. Still they do not seem to cause the very high temperature often found in the silo without a partial supply of air. The high temperature occurring shortly after the material is put in the silo does not destroy the bacteria and molds which later cause acid fermentation and putrefaction. After the heating, however, the silage settles and the air is excluded. The initial high temperature which these bacteria induce is therefore probably most serviceable by causing this closer packing of the silage and the exclusion of the air, rather than by killing the germs of other ferments.

Fermentation at lower temperature—Lactic and acetic ferments—Development of acids in silage.—The ferment which induces the formation of acetic acid in vinegar and that which causes the formation of lactic acid in milk are both active in the silo. Neither of these can grow in any known medium at a temperature above 47° C. (117° F.). The most favorable temperature for the former seems to be about 38° C. (100° F.), and for the latter, not above 33° C. (98° F.). Both ferments are aerobic, *i. e.*, requiring an abundance of air. Thus the formation of vinegar from sugar in a liquid kept in a tight barrel is slow, but when exposed to air, it goes on rapidly.

Corn stalks as cut for silage contain a considerable amount of acid, and this does not appear to decrease during the fermentation in the silo. They also contain a considerable amount of sugar which is changed to acids by ferments. The hot fermentation, however, prevents acidity by making the mass more compact so as to exclude the air which is necessary to the activity of the ferments.

Sweet silage.—Silage, however treated, contains the acid originally in the corn stalks. Sweet silage is that which has a relatively small quantity of acid formed by fermentation. What commonly passes for sweet silage is not always the same thing. It may be obtained either with or without heat. When slow filling of the silo with consequent high temperature is relied upon, the fermentations are very different from those of the sweet silage obtained without heat. By rapid filling and close packing, especially with the more mature and dry corn, the mass remains sweet, because little fermentation follows. When the fermentation is depended on for heat there is more loss.

Results of chemical investigations.—In chemical examinations of silage from Burr's White and Burrill and Whitman corn, the volatile acids separated by distillation, and formation of their barium and other salts, ranged from 0.397 to 0.686 per cent of the weight of the silage. A rough quantitative determination of these acids in one case gave about 79 per cent of acetic, 18 per cent of butyric, and 2 per cent of valeric acid, with other acids present in small quantities. In another case a small quantity of lactic acid was found. Mannite also occurred. The non-volatile acids varied from 1.31 to 2.05 per cent. Analyses of the gases in the silo revealed about 15 per cent of carbonic acid and from 2 to 2½ per cent of oxygen. The remainder was supposed to be mainly nitrogen. Analyses of samples of silage from five other sources gave volatile acids ranging from 0.024 to 0.979 per cent, and non-volatile acids from 0.330 to 1.767.

Field experiments with oats, 1888–89, T. F. Hunt, B. S. (pp. 194–213).

1. *Quantity of seed per acre.*—Seven plats were sown two years with from 1 to 4 bushels per acre. 2. *Compact or loose seed bed.*—Four methods of preparing the seed bed are compared, ranging from very

compact to very loose. 3. *Time of sowing.*—Seed was sown at intervals of one week from April 6 to 27, 1888, and from March 14 to April 25, 1889. 4. *Depth of sowing.*—The depths varied from 1 to 6 inches. The number of plants growing at different dates, yield of grain and straw, and the number of shoots and heads are given in tables. 5. *Test of varieties.*—The tests included twenty-nine varieties obtained from seedsmen, and "two varieties, Welcome and common mixed oats, grown some years with good results on the University farms." These varieties are classified as very early, early, medium, late, and very late maturing, and each is briefly described. There are also notes on the vitality and purity of the seed, the yield, date of ripening, plumpness of berry, color, kind of panicles, weight of grain per bushel, weight of berries, and quality as indicated by the ratio of kernel to berry and the relationship between per cent of kernel in the berry and the weight per bushel, the color, weight, and plumpness of the berry, together with tabular data.

The results from all the experiments reported are thus summarized:

(1) In 1888 the largest yield was produced when 2½ bushels per acre were sown; in 1889, when 3½ bushels were sown. Both years considered, the yield was related to the quantity of seed sown from most to least as follows: 3½, 4, 3, 2½, 2, 1½, and 1.

(2) A medium loose seed bed gave a larger yield in both seasons than a compact or very loose seed bed.

(3) Almost without exception the earlier the seeding the larger the yield and the greater the weight per bushel. Oats sown March 14, 1889, yielded half and nearly twice as much more than oats sown April 4 and 18, respectively.

(4) Between 1 and 4 inches in depth the differences in yield do not indicate with certainty that the depth of sowing affected the results.

(5) In many cases varieties of oats under distinct names resemble each other so closely as to be practically identical.

(6) Thirty-three plats, including varieties under thirty names, gave the rather low average of 41 bushels per acre. The largest yield was 54 and the least 30 bushels per acre.

(7) There was an average of somewhat less than 2 pounds (1.84 pounds) of straw for each pound of grain. The variation in the yield of straw was a little less than that of the grain.

(8) The following varieties gave the largest yields, in the order named: Giant Yellow French, Early Dakota White, Improved American, Japan, White Bonanza, and American Banner; while Canadian Black, Virginia Winter, White Belgian, Black Tartarian, and Texas Rust-Proof gave the poorest yields.

(9) All things considered, it may probably be fairly concluded that the earlier ripening varieties were the more desirable.

(10) Neither the length, plumpness, or weight of berry, nor the weight per bushel appreciably influenced the yield.

(11) The white varieties were considerably superior in yield and weight per bushel to the black and dun-colored varieties.

(12) The varieties with closed panicles yielded somewhat better than those with open panicles.

(13) The average per cent of kernel in the berries as sown was 69.6 per cent, and 65.1 per cent in the crop. The largest individual difference between two varieties was 19.3 per cent in the seed and 12.7 in the crop. This extreme dif-

ference between two varieties would make a difference of $39,000,000 if applied to the annual crop of the United States. Differences, not beyond control, would make a difference of $8,000,000 to $9,000,000 in the annual value of the crop.

(14) Those varieties which contained the higher per cent of kernel in the berry of the seed sown, contained, on an average, the higher per cent in the crop and gave the larger yields.

(15) On the whole, it is doubtful whether there was any relation between the per cent of kernel in the berry and the weight per bushel, the color, weight, or plumpness of the berry. If any such relation existed, those varieties with long, slender berries, with lighter berries, and with the less weight per bushel yielded the highest per cent of kernel.

(16) While it appears from the data obtained that it is especially desirable to sow varieties of oats whose berries contain a large per cent of kernel, this quality, with our present knowledge, can only be known by direct determination.

(17) The 29 varieties of oats procured for seed from the leading seedsmen of the United States were practically free from foreign seeds and other impurities.

(18) On an average, 93 per cent of the berries sprouted. In 15 varieties 95 or more per cent sprouted, while in 3 varieties less than 80 per cent sprouted.

(19) If future investigation confirms the experiments just recorded, the practical lesson will be to sow as early as practicable, in a medium loose seed bed; to cover well, but not necessarily deep; to use 2½ to 3½ bushels of seed per acre; to ascertain the power of sprouting of the seed, and, if low and it is necessary to sow it, to sow proportionately more; to sow white varieties which have been found through a series of years to produce a good yield with a high percentage of kernel to berry.

INDIANA.

Agricultural Experiment Station of Indiana.

Department of Purdue University.

Location, La Fayette. Director, Horace E. Stockbridge, Ph. D.

BULLETIN No. 26, JULY, 1889.

WHEAT RUST, H. L. BOLLEY, M. S. (pp. 5–19), (illustrated).—This article opens with some general explanatory notes on fungi and on the loss occasioned by wheat rust in England and the United States, after which the species of fungi causing rust are described and discussed, with special reference to observations by the author. Conditions affecting the development of rust are also stated, with a view to suggesting means for the prevention of this disease. The bulletin is illustrated with cuts made from original drawings.

The annual damage to wheat from rust in Indiana alone is estimated to exceed $300,000. Besides the direct damage rust may so weaken the plant that it will be more easily injured by frost.

Three species of fungi, *Puccinia graminis*, *P. coronata*, and *P. rubigo-vera*, may cause rust on wheat. "The last two species do not in their mature form rupture the surface covering of the plant, but produce the spores (*teleutospores*) under the epidermis, and are therefore less easily visible; yet their development is none the less extensive. All three of these species are also common to oats, barley, rye, and various of the grasses. Many grasses are also subject to other species peculiar to themselves. Every farmer has in these rusts dangerous foes which, when conditions are favorable, very materially reduce the yield and the value of the crop." Wheat rust belongs to a division of rusts known to botanists as *heterœcismal*, by which is meant that the fungi causing these rusts develop in several apparently distinct stages or forms, one of which appears on some plants very dissimilar to those on which the first form develops. In the first or summer stage the wheat-rust fungi produce what is called "red rust," which may develop later in the season into the second stage, known as "black rust." Black rust is much more injurious to the crop than red rust. Early ripening varieties of wheat may, therefore, escape comparatively unharmed, while those ripening late may be badly damaged by the rust. From the spores of the black rust is developed a third form of the fungus, known as an *æcidium*, which, however, does not seem to be necessary to the continuation of the species, but constitutes a side form whose functions are not yet well understood. The *æcidia* do not grow on grain, but on very different plants. "For *Puccinia graminis* various species of the barberry have been determined as capable of bearing the alternate form. The buckthorns of the genera *Rhamnus* and *Frangula* support that of *P. coronata;* and the æcidium of *P. rubigo-vera*, the rust of which is undoubtedly the one most prevalent on wheat in Indiana, has been found to grow upon various species of the borage family, such as the common hound's-tongue (*Cynoglossum officinale*), a roadside weed in the older sections of the country."

Observations made by the author seem to show that one species (*P. rubigo-vera*) of wheat rust, in its uredo (red) stage, is able to pass the winter in the tissues of the natural wheat plant, and to develop with great rapidity early in the spring. Among the conditions affecting the development of rust the following are mentioned:

"In warm weather any conditions of the soil or atmosphere which tend to keep the wheat leaves constantly wet are conducive to the rapid spread of the disease. Low-lying, rich soils are most subject to the disease. No variety of wheat is known to be rust-proof, yet some possess greater powers of resistance than others. Fulcaster, Egyptian, and Dietz Longberry are specified as among the resistant varieties. Though not proved, an excess of nitrogen in the soil is to be considered probably as liable to produce wheat easily affected by rust. If fertilizers are to be applied to such lands, those containing only inorganic elements are most advantageous so far as immunity against rust is concerned. In districts liable to severe visitations of the disease early ripening wheats are to be preferred.

"Although the spores of the red rust are formed most abundantly in the spring and early summer, they are also developed until late in autumn upon various grasses, and may be wafted by winds to the young wheat. Volunteer growths of wheat upon old stubble fields furnish good hosts upon which the formation of these spores may be continued throughout the summer, and hence should be pastured down or otherwise removed the same as other weeds."

BULLETIN No. 27, AUGUST, 1889.

FIELD EXPERIMENTS WITH WHEAT, W. C. LATTA, M. S. (pp. 3–12).—*Comparison of varieties.*—Twenty-three varieties were compared. Data as to the produce, time of ripening, hardiness, strength of straw, whether bearded or smooth chaff, color of chaff and grain, and weight of measured bushel of grain, are given in tables. In 1888 Egyptian, Michigan Amber, and Velvet Chaff gave the largest yields; in 1889, Egyptian, Golden Cross, and Raub's Black Prolific were the most productive. Golden Cross and Sibley's Imperial are thought to be identical, as are also Mealy and Brown Smooth Velvet Chaff. Red Fultz, German Emperor, and Michigan Amber are much alike.

Quantity of seed to the acre.—"Experiments to ascertain the most desirable rate of seeding have been conducted six years on ground of average fertility, well prepared and naturally drained, and with good seed drilled in without fertilizers, in the last third of September." From 2 to 8 pecks of seed per acre have given an average yield of 18 to 31 bushels during five years, the yield increasing steadily with increased thickness of seeding. "The evidence steadily accumulates in favor of thick seeding. For rates higher than 6 pecks the increase in yield is slight, but enough to justify the extra amount of seed required." "For lands in average condition I would not recommend less than 6 pecks per acre, and doubt not that in many cases thicker seeding would give better results."

Broadcast and drill seeding.—The results of four trials (1884–88) of broadcast and drill seeding are given in a table. The yield of drilled plats averaged 24.12 bushels, that of broadcast plats, 16.65, making the gain from use of the drill 7.47 bushels per acre. The broadcast plats were damaged most in winter, much of the seed being left too near the surface and the roots being thus exposed by rain. In the case of the drilled wheat the rain covers up the exposed roots. "The superiority of the drill, at least on the compact though naturally drained soil of the Station farm, is plainly manifest."

Large and small seed.—Seeds which passed through the seed screen of a fanning mill were classed as "small," those which did not pass through as "large." Large and small seeds were sown side by side at the same rate, 6 pecks per acre. The result was inconclusive, but the experiment will be repeated.

Continuous grain growing vs. rotation cropping.

Two series of experiments were begun in 1880 to determine the effect of grass on the yields of grain crops in a rotation involving both. In one series there are no grass crops, but wheat is grown every year on some plats, and every second year on other plats in alternation with both oats and corn. A second series is devoted to three rotations, five, six, and seven courses, respectively, each of which involves, among other crops, one of wheat and two of grass (timothy and clover) in the rotation. The entire crop of grain, straw, stalks, hay, etc., has been removed in every case. No manure has been used on either series for nine years at least, and probably not for a much longer time. In all respects, except the order of cropping, the treatment of the two series has been exactly the same. Grass and clover therefore constituted the essential difference between the series.

The average yield per acre for the last three years has been as follows: "First series, grain crops only, 10.7 bushels; second series, grain and grass crops, 15.5 bushels; gain from rotation cropping, 4.8 bushels." The yields of corn and oats also show the benefit of rotation. The smallness of the yields is due to the absence of manure.

Suggestions to wheat growers.—The following practical suggestions are based on the experience with wheat at the Station:

"(1) Sow less wheat; grow more grass and better live stock.

"(2) Select a hardy, prolific wheat, adapted to your soil, and stick to it. Give it good treatment and it will not 'run out.' Sow not less than 6 pecks of sound seed to the acre.

"(3) Plow wheat ground early and harrow immediately. You can thus more easily and more thoroughly pulverize the soil.

"(4) If ground breaks up cloddy, use heavy roll, alternating with some form of harrow or cultivator that will bring clods to the surface.

"(5) If manure or fertilizers are used, mix thoroughly with soil in every case. Use only rotted manure, if any, and apply after plowing. Reserve the fresh manure for the corn crop.

"(6) Before trying a fertilizer get the experience and advice of farmers whose soils are similar to your own.

"(7) Test the untried brands carefully, in a small way, before deciding upon their extensive use. This is the best course, for even the highest grades often act very differently on different soils.

"(8) Adopt a rotation of crops suited to your soil and needs. It will (1) increase the yield and improve the quality of your crops; (2) enable you to take better care of your live stock; (3) prevent serious insect depredations and fungous diseases; (4) improve your soil and make it more lasting, and (5) put money in your pocket.

"(9) Bear in mind that soils and climate vary greatly in different localities and that these potent factors in crop production will very materially affect the results of your work. Therefore study your local conditions, and intelligently apply the lessons of this bulletin only so far as they may be suited to your needs and surroundings."

Weather summary from July 1, 1888, to June 30, 1889.

BULLETIN No. 28, SEPTEMBER, 1889.

SMUT OF WHEAT AND OATS, J. C. ARTHUR, D. Sc. (pp. 3–23), (illustrated).—This is a useful summary of what is known on this subject with practical directions to aid farmers in combating the evil. Both black and stinking smut are discussed, but chiefly the latter. Indeed the bulletin was written "to meet the demand for information in the northern part of Indiana, where there has been a very unusual loss of wheat in the crop just harvested on account of stinking smut."

Stinking smut (*Tilletia lævis*, Kuehn, *T. foetens*, Ravenel) (pp. 3–19).—There was a serious outbreak of this disease in La Grange County, Ind., in 1889. In one field examined by the author more than 50 per cent of the crop was lost by reason of the smut. The subject is treated under the following heads: Amount of loss, description of the fungus, early opinions regarding it, external character, name, growth, and reproduction, attack and spread of the disease, natural checks to increase, nature of the injury, remedies and precautions. Two forms of stinking smut are known, *Tilletia tritici*, common in Europe, especially in the British Isles, and *Tilletia lævis*, or *foetens*, which is the prevailing form in this country. The spores of the former are round and minutely roughened, while those of the latter are rather larger, irregular, and entirely smooth. This distinction can be observed only with the microscope. The author believes that the name *Tilletia foetens* should be adopted as the one printed first by Ravenel in 1860.* The disease does not spread from plant to plant or from field to field while the crop is growing, but the infection takes place at the time the seed sprouts.

> Spores of the fungus, which are very nearly or quite in contact with the germ end of the wheat grain, or touching the young plantlet between its attachment to the seed and the first joint, can grow into the tender tissues of the plant as the seed sprouts, and drawing nourishment from the juices develop along with the wheat, and finally produce spores in the kernels. A single spore may thus cause all the heads of a stool of wheat to smut.

The spores are either in the soil or are sown with the seed. Great care must therefore be taken to sow clean seed. A single smutted kernel may contain several million spores, and if this kernel is crushed in a bin of seed wheat and the spores thus distributed the crop produced from such seed would probably be very largely ruined. The disease may also be conveyed to the seed through a thrasher, fanning-mill, seeder, bin, or sack which has been used about smutted wheat and not properly cleansed afterwards. It is also probable that the spores of wheat smut, like those of corn smut, retain their germinating power in the manure dropped by animals fed on smutted wheat, and such manure should, therefore, not be used in the wheat field. "When kept dry the spores retain their power of germination two or three years, or even longer," but under the conditions found in the field probably not over two years. Insufficient moisture in the soil and resistant varieties of wheat seem to be among the natural checks on the increase of this disease. "Where there is danger of infection do not sow wheat on wet or insufficiently drained land and use a variety of wheat least affected by smut." Rotation of crops will do much toward cleaning a soil that has become infected with smut. "Do not follow smutted wheat with wheat again for one, or better still, for two years." Various fungicides have been used to purify seed wheat infected with smut. Sulphate of copper (blue vitriol) is now largely used for this purpose. Different methods for its application are explained in the bulletin, but the author advises to thoroughly wet the smutted seed "with a solution of blue vitriol, using one pound or more to a gallon of water, and either sow damp or first dry with plaster or slaked lime." No remedy can be used after the grain is sown, but "clean seed upon a clean field will result in a clean crop." To prevent smut on wheat "costs not a fraction of the trouble or expense that it does to remove the Colorado beetle from potato vines," while inattention to this disease may result in loss.

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* See Ravenel, Fungi Caroliniani Exsiccati, V. 1860, No. 100.

Black smut (*Ustilago segetum*) (pp. 19–23).—This smut is odorless, not very conspicuous in the field, and does not show in the thrashed grain. For these reasons a loss of even 10 per cent of the crop rarely attracts attention or comment. Black smut is more common than stinking smut, and attacks wheat, oats, barley, and rye. Essentially the same means should be taken to keep a farm free from black smut as were recommended in the case of stinking smut, but when blue vitriol is used as a fungicide for black smut, grain with hulls, like oats and barley, should be soaked longer than wheat.

BULLETIN No. 29, DECEMBER, 1889.

GRASSES OF INDIANA, J. TROOP, M. S. (pp. 5–44) (illustrated).—This contains brief, popular descriptions of 128 species in 50 genera of grasses found in Indiana. The descriptions are illustrated with 19 plates taken from the Reports of the United States Department of Agriculture, and Professor Beal's "Grasses of America."

IOWA.

Iowa Agricultural Experiment Station.

Department of Iowa State College of Agriculture and Mechanic Arts.
Location, Ames. Director, R. P. Speer.

BULLETIN No. 6, AUGUST, 1889.

EXPERIMENT STATION WHEAT AND OATS IN 1889, R. P. SPEER (pp. 199–203).

Wheat.—From the effect of rust, blight, chinch-bug, deterioration of the soil, and other causes, the wheat crop in Iowa has declined from an average of 20 to 30 bushels per acre twenty years ago to not more than half that amount now. The people of Iowa are compelled to send to Minnesota and Dakota for large quantities of breadstuffs. The Iowa Station is, therefore, endeavoring to find hardier and more productive varieties of wheat which may be profitably grown in that State. In 1888 rust and blight rendered the experiments with twelve varieties of no avail, and the same was largely true in the case of six varieties planted in 1889. Velvet Chaff Blue Stem and Saskatchawan, however, gave large yields and were only slightly injured by rust. It is thought that drainage and the growing of clover in the wheat fields will be decidedly beneficial.

Oats.—Fifteen varieties sown broadcast produced larger yields and were less injured by rust and blight than the same varieties planted in rows 3½ feet apart. Prize Cluster, Everett, and Salzer's White Bonanza are especially recommended as desirable varieties.

FEEDING EXPERIMENTS WITH STEERS, G. E. PATRICK, M. S., AND L. P. SMITH, M. S. (pp. 205–239).—Made by the farm department of the College and the Station, who divided the expense.

The objects aimed at were (1) to compare the feeding value in fattening of timothy hay, corn fodder, corn silage, and sorghum silage as coarse foods, and corn-and-cob meal and bran as grain, one or more kinds of coarse food being used with one or more kinds of grain in each ration; (2) to compare corn-and-cob meal with whole corn, and (3) to compare cost of outdoor with that of indoor winter fattening. Twelve steers, divided into six lots of two each, were fed during three periods of four or five weeks. The reasons for so large an experiment with so few animals are given, one being "that practical problems in farming are many, and farmers want facts on as many of them as possible and as soon as possible." The sources of error, which included marked differences in the animals, evidently due to individuality, are discussed and the effects to counterbalance them explained. The results are stated in detail in eleven tables. The conclusions, which of course need verification by further experimenting, are as follows:

(1) With corn-and-cob meal as the only grain of the ration, corn fodder proved more profitable as the sole coarse fodder, than timothy hay, corn silage, or sorghum silage (both the last named being acid, not "sweet").

(2) Under the same conditions, timothy hay proved more profitable than did the silage with most animals. The two steers which did so poorly with silage as the sole coarse-fodder ration ate it with evident relish as a part of more varied rations.

(3) No difference could be detected, with anything like certainty, between corn silage and sorghum silage as regards feeding value. The fact that two of the four silage-fed steers did not relish their food rendered any just comparison impossible.

(4) The addition of timothy hay to a ration consisting of corn-and-cob meal and corn silage materially reduced the cost of the gain made. With the same addition to rations of corn fodder and corn-and-cob meal or shelled corn the reduction in the cost of gain was no more than could reasonably be ascribed to the warmer weather of the period when the timothy was fed.

(5) A varied ration, consisting of wheat bran, corn-and-cob meal, corn fodder, timothy hay, and either silage or mangels, produced gain much more cheaply than was done by corn-and-cob meal and timothy, or by corn-and-cob meal and silage. It was not compared directly with either the shelled corn and corn fodder or the corn-and-cob meal and corn-fodder ration; and to draw conclusions from indirect comparison would in this instance be unsafe, because the effect of the different feeds which the animals had received during the previous period can not be measured.

(6) Shelled corn produced gain more cheaply than did the same value of corn-and-cob meal.

(7) Outdoor fattening was found considerably more expensive than indoor fattening, so far as cost of food is concerned, even during the exceptionally mild winter of 1888–89.

A new form of recording desk (pp. 237–239).—A modification of the recording desk described in Bulletin No. 4 of the Minnesota Station is explained and illustrated. The purpose of the modification is to expose more of the record to view at one time. This is done by passing the paper under a piece of stout glass tubing and upward to a second roller placed about eighteen inches above the top of the desk.

FOOD HABITS OF THE STRIPED PRAIRIE SQUIRREL (SPERMOPHILUS 13-LINEATUS), C. P. GILLETTE, M. S. (pp. 240–244).—Examination of the contents of the stomachs of more than twenty of these squirrels indicated that injurious insects, especially cut-worms, web-worms, and grasshoppers, constituted a large proportion of their food and were preferred by them to grass, clover, and other green stuffs. It is inferred, therefore, that lawns, meadows, and pastures are benefited by the squirrels, and that if some method could be devised to prevent their digging up the corn after it is planted they would prove a decided help in keeping worms from injuring corn.

BULLETIN No. 7, NOVEMBER, 1889.

EXPERIMENTS WITH CORN, R. P. SPEER (pp. 247–260).—This contains notes on methods of preparation of the soil and cultivation of the crop, the working of different cultivators, subsoiling, surface tillage, drainage, and the action of manures. The characteristics of several different varieties of corn are discussed at some length, with observations on the effects of cross-fertilization, especially as seen in experiments at this Station. The results of experiments in 1888 (See Bulletin No. 2 of Iowa Station) with reference to the tassels, silks, and blades of different kinds of corn, which have been verified in 1889, are stated to be as follows:

(1) The tassels and the silks of primary ears appear generally about the same time.

(2) The upper central spikes of the tassels shed their pollen usually about twenty-four hours before the pollen of their lateral spikes is ready to fall.

(3) The first silks which protrude through the husks are from the lower ends of the ears and the silks above them follow gradually until all are exposed.

(4) Usually twenty-four hours elapse before silks are in a receptive condition, after their first appearance.

(5) Generally the silks at the tops of ears are from two to five days later in appearing through the husks than the lowest; but frequently the upper silks are not more than twenty-four hours later in appearing than the lowest, and sometimes they are ten days later.

(6) When the lowest silks appear four or five days before those at the upper ends of ears, the lower grains of corn will be old enough and sufficiently strong to rob the younger and weaker upper grains, and cause them to die from starvation. Therefore, when there are such differences, the ears will not be properly filled at their upper ends; but when the difference amounts to only twenty-four hours or less, the ears will be as fully developed at their upper ends as at their lower ones.

(7) When well grown, the best corn for Iowa will not exceed 9½ feet in height, its ears will be 3½ feet from the ground, and each of its stalks will have thirteen blades.

Fifteen varieties of dent, two of flint, and twelve of sweet corn were grown at the Station in 1889. Leaming and Edmundson are considered " the most valuable of all the kinds we have tested for Iowa," the latter being especially adapted to the northern part of the State. King of the Earlies is also favorably regarded. The characteristics of ears of different varieties are illustrated in the plates accompanying this article. In the author's opinion, the variety which is wanted for central Iowa must complete a season's growth in one hundred and fifteen days of ordinary summer weather. In addition to the characteristics mentioned " it should have well-developed blades on the points of its husks, and long ears, having thirty rows of deep grains on each ear, and the ears should be equally large at both ends and show no missing grains." " It is not safe to plant corn in Northern Iowa which will not ripen by the 10th of September, and for Central Iowa it should not be more than five days later."

Millets, buckwheats, and the new prolific tree bean, R. P. Speer (pp. 261–263).—This contains notes on varieties of millet and buckwheat and on the new prolific tree bean. The need of care in the selection of seed is emphasized. The new prolific tree bean has been found to be preferable to the common navy bean during the two years in which comparative tests have been made at this Station.

Sugar experiments, R. P. Speer (pp. 264–269).—An account of an inconclusive experiment to test the Jenning's process of making sugar from sorghum. The failure to make sugar in this case is stated to be " because we were not ready for work when the sorghum was ripe, and because the greater part of the cane which we worked contained only from 6 to 10 per cent of sucrose." " Our experience this year proved that there is much to be learned in the sorghum fields as well as the factories." The author is, however, confident that the making of sugar from sorghum by the diffusion process will yet become a leading industry in several of the Western States, and is an advocate of the establishment of small factories.

Codling moth experiments, C. P. Gillette, M. S. (pp. 270–280).—This is a record of an experiment at this Station in 1889, on thirteen Duchess apple-trees, with the following insecticides, for the codling moth: A dry mixture of Paris green and plaster (1 pound of the former to 100 pounds of the latter); a solution of London purple (1 pound to 128 gallons of water); carbolized plaster (1 pint of crude carbolic acid to 100 pounds of common land plaster). Four trees were used as checks, *i. e.*, were not treated with any insecticide. When the results were reckoned up in the ordinary way it appeared that "the Paris green and plaster application saved 94 per cent, the London purple 68 per cent, and the carbolized plaster 34 per cent of the fruit, which would have been wormy in the absence of any treatment." The author would not recommend the carbolized plaster, even if better results were obtained from its use, because "it does not kill the insect in any of its stages, but simply drives the moths to seek the fruit of neighboring trees on which to deposit their eggs."

The fact that "except in northern latitudes, where the insect is single brooded," the ordinary method of estimating the results of such experiments gives too small percentages of fruit saved, is dwelt upon at considerable length. The author holds that "in order to estimate the actual protection obtained, the counts for the two broods must be kept separate." In this way alone will proper account be taken of "the great number of eggs that will be laid upon the sprayed trees by moths flying in from the checks, as well as the smaller number of eggs which will be laid on the checks, because of the great number of larvæ of the first brood destroyed on the treated trees in their vicinity." Tables are given in which approximate data for the two broods in the experiment reported are recorded separately.

New cynipidæ, C. P. Gillette, M. S. (pp. 281–285).—Notes on five species.

The hog louse (Hæmatopinus suis), C. P. Gillette, M. S. (pp. 286–289).—An account of a successful experiment in spraying lousy pigs with kerosene emulsion.

The College vineyard, J. L. Budd, M. H. (pp. 290, 291).—Twelve years' experience has confirmed the author's opinion that root killing of young grape-vines may be prevented "by setting the plants in the bottom of holes 18 inches deep." The varieties in this vineyard, which have fruited regularly and endured drought best, are Concord, Worden, Moore's Early, Dracut Amber, Telegraph, and Cottage.

KANSAS.

Kansas Agricultural Experiment Station.

Department of Kansas State Agricultural College.
Location, Manhattan. Director, E. M. Shelton, M. S.

BULLETIN No. 7, JULY, 1889

EXPERIMENTS WITH WHEAT, E. M. SHELTON, M. S. (pp. 77–87).—The description of these is prefaced by a brief argument in favor of wheat raising in the State, in which it is urged that "wheat raising upon a large scale and carried on as a specialty deserves condemnation in Kansas as elsewhere: but when the crop is grown as part of a system in alternation with corn, oats, grass, and other crops, it is almost certainly a profitable one to the farmer." On the College farm the average yield for sixteen years, including three total failures, has been 18¼ bushels per acre, and the average selling price 80 cents per bushel. The acreage of this staple, however, has been subject to wide fluctuations, and since the short crops of 1885, 1886, and 1887, wheat in many counties of the State has ceased to be prominent as an agricultural product. To the objection that wheat furnishes shelter and support to chinch-bugs early in the season, enabling them to pass directly from the wheat to the adjoining fields of corn and oats, it is replied that this danger has been greatly overestimated; that in sixteen years no corn crop has been lost on the College farm from the action of the chinch-bugs, and that when damage has been done "the action of these insects has always been to emphasize the effects of drought."

Pasturing wheat (pp. 78, 79).—An experiment undertaken the previous year was repeated in 1889 to determine what effect close pasturing by cattle would have on growing wheat. No result of value has thus far been reached.

Experiments with varieties (pp. 79–81).—Nineteen varieties of wheat were grown on small plats. The results, recorded in a table, were deemed of little value except as forming those of one experiment in a series necessary to afford an approximation to the truth. For many years the main crop of the College farm has been either the Red May or Zimmerman variety. Both, however, together with the Little May and Big May, are believed to be one and the same variety, a wheat stooling enormously under favorable conditions, ripening early, yielding heavily, having excellent flouring qualities, and showing marked endurance of hot, dry weather, but somewhat susceptible to winter-killing. From observations at the Station it is concluded that wheats really successful in Kansas are the reds, soft or hard.

Fertilizers and methods of cultivation (pp. 81–86).—Forty-five one-twentieth-acre plats were laid off side by side on a strong clay loam of ordinary fertility, manured and cultivated plats alternating with those receiving no fertilizers or unusual cultivation. Six plats were treated with salt at the rate of 300 pounds per acre—two in spring, four in fall; four were subsoiled; four were cultivated; four received barn-yard manure at the rate of 25 tons per acre; two, superphosphate, 400 pounds per acre; and two, nitrate of soda at the same rate. The yields of each plat are stated in a table and presented graphically in a diagram. Summaries for each method of manuring and cultivation as compared with the adjacent check plats are given in another table. "The plats treated with salt, taken as a whole, show no increase of grain, and only a very slight gain in straw, over the unsalted." In comparing these results with those of a similar experiment made in 1888, when an average gain of nearly 5 bushels of grain and 800 pounds of straw was recorded for salted plats, it is stated that "these facts are in direct accord with previous experiences had with this fertilizer. Upon certain soils and during particular seasons salt has proved valuable, but quite as often it has been inert and worthless as a fertilizer." The hopes recently raised in Kansas regarding the influence of salt are believed to be "for the most part extravagant, and not likely to be realized in practice."

The barn-yard manure, which, with the other fertilizers, was applied broadcast in the fall and harrowed in, is reported to have had an unfortunate effect, loosening the upper soil and permitting it to dry out to such an extent that a large proportion of the wheat failed to germinate. The effects of the superphosphates and nitrate of soda were likewise unfavorable. "The above experimental facts show strikingly that the better class of Kansas soils, when well farmed, during favorable seasons require little in the way of artificial stimulation."

SALT APPLIED TO OATS, E. M. SHELTON, M. S. (pp. 86, 87).—To study further the influence of salt as a fertilizer, six one-tenth-acre plats were sowed with oats, and salt at the rate of 300 pounds per acre was applied to each alternate plat in the series. The increase (as shown by the tabular record) from the salted as compared with the unsalted plats was at the rate of 3 bushels of grain and 270 pounds of straw per acre, a rate by no means profitable.

LISTING WHEAT, E. M. SHELTON, M. S. (p. 87).—In this experiment three small double shovel plows were secured to the frame-work of a "Buckeye" one-horse drill so as to make a 6-inch deep furrow in advance of the three discharge spouts of the drill. By this means seed wheat was placed in furrows 8 to 10 inches deep and about 14 inches apart. The wheat appeared somewhat earlier, made a ranker growth, and seemed superior to that which had been seeded upon the surface. The winter, however, furnished no test for the main question involved (whether listing would enable winter wheat to withstand freezing), and further experience will be necessary to determine the merits of this method of seeding.

BULLETIN No. 8, OCTOBER, 1889.

PRELIMINARY REPORT ON SMUT IN OATS. W. A. KELLERMAN, PH. D., AND W. T. SWINGLE (pp. 91–104). (illustrated).—This contains brief notes on the name and history of this disease; an account of the nature and extent of the injuries caused by it, its botanical and microscopic characters, and methods of prevention, with special reference to that proposed by Professor Jensen, of Copenhagen, Denmark; a record of experiments by the authors, and brief notes on some of the natural enemies of the smut. There are also brief statements regarding stinking smut, with the announcement that experiments with fungicides for this disease are in progress at the Station. The natural enemies of the smut in oats, described in this article, are a white mould, black mould (a new species of *Macrosporium*), a species of bacteria, probably, and two beetles, *Phalacrus* (sp.?) and *Brachytarsus variegatus*, Say. The experiments recorded had the following results:

(1) Verification of results obtained by Professor Jensen showing that grains still included in the husk can not be infected by spores in contact with the exterior of the husks, and that, therefore, the disease can not be spread by spores in the soil or manure.

(2) Verification of the effectiveness of the remedy proposed by Professor Jensen, which consists in simply dipping the seed in water at a temperature of 132 degrees F.

(3) Solutions of iron sulphate (1½ pounds per gallon), copper sulphate (4 ounces to 1 gallon, eighteen hours), concentrated lye (5 per cent), and sulphuric acid (3 per cent and 10 per cent), either did not decrease the amount of smut or were injurious to the seed.

BULLETIN No. 9, DECEMBER, 1889.

EXPERIMENT IN PIG FEEDING. E. M. SHELTON, M. S., AND H. M. COTTRELL, M. S. (pp. 107–119), (illustrated).—This experiment is substantially a repetition of one made in 1888, differing from that, however, in the age of the animals fed, those in the previous experiment having been mature, while these were young pigs. The object was to observe the effect of a nitrogenous ration (shorts and bran) and a carbonaceous ration (corn meal and potatoes) on the composition of the carcass of young growing pigs, especial attention being paid to giving the food in such forms as to secure the largest possible consumption of it by the pigs. Ten Berkshire pigs were used, which, at the beginning of the experiment, were from fifteen to twenty-one weeks old, and averaged 68.4 pounds in weight. The trial continued fifteen weeks, from August 13 to November 25, 1889. During this time five of the pigs were fed with shorts and bran cooked in equal proportions. The other lot of five pigs received cooked corn meal, to which 5 per cent of tallow was added. From the seventh to the twelfth week, inclusive, the corn-fed pigs received equal parts of corn and potatoes. Both lots received whatever salt they required, and an abundance of cob charcoal.

Tables show the live weight, gain in weight, gain per hundredweight, feed consumed (shorts-bran, corn meal, corn meal and potatoes), cost in pounds of feed of 1 pound of increase for each pig during each week of the experiment, and for each lot; the total gain in weight; average gain per hundredweight; feed consumed; and the cost in pounds of feed of 1 pound of increase, at three periods during the experiment. One of these periods included the time when corn meal and potatoes were fed; the other two, the time before and after feeding this ration. At the end of the fifteenth week, when the pigs were slaughtered, the average live weight per pig was 201 pounds. There is also a record of the live and dressed weight, per cent of shrinkage, weight of blood, tongue, heart, lungs, liver, kidneys, spleen, stomach, uterus, tenderloin, intestinal fat, and leaf lard for each pig; the average per pig and per hundredweight of dressed pig for each lot, and data regarding the weight and strength of the left femur bone of each pig. Photographs of cross-sections of each animal at the middle loin and between the sixth and seventh ribs are reproduced in the bulletin.

The meat of the shorts-bran-fed pigs was of a darker color, and contained not only a greater proportion of lean to fat but also a greater "actual amount" of lean meat; the lungs, intestinal fat, and leaf lard weighed less; the blood, liver, kidneys, uterus, stomach, and tenderloin weighed more; and the per cent of dry matter in the lean meat, as well as in the fat, was less. The average strength of the left femur bone was greater in the shorts-bran lot.

"The corn-potatoes-fed pork was pure white and firm to the touch, while that from the shorts-bran-fed pigs was in color a dirty yellow and in texture soft and flabby." Cooking tests, made by roasting, frying, and boiling portions of flesh from each lot, indicated that the meat from the corn-potatoes-fed lot had some advantages over that from the shorts-bran-fed lot. Two of the roasts showed "no appreciable difference in texture and flavor, while the shorts-bran meat of two others was pronounced distinctly drier, harder, and more fibrous." "The frying revealed, in every case reported, a hard toughness in the meat of the shorts-bran meat not noticed in the flesh of the other series." The meat of the shorts-bran series also shrank more by boiling.

The record of this experiment on growing pigs, compared with that of the experiment of 1888 on mature hogs, indicates that while in the first experiment the corn-fed lot ate the largest daily ration, made the largest average daily gain, and the largest gain per hundredweight of live weight, but required more food to make a pound of increase than the shorts-bran-fed lot, in 1889 the results in these particulars were reversed. In both experiments the lungs, liver, and other "vital parts" of the pigs fed on shorts and bran were as a rule heavier than those of the pigs in the other series. The bones of the mature, corn-fed swine were stronger than those of the shorts-bran-fed pigs of the same age. In the case of the growing pigs the reverse was true.

KENTUCKY.

Kentucky Agricultural Experiment Station.

Department of the Agricultural and Mechanical College of Kentucky.

Location, Lexington. Director, M. A. Scovell, M. S.

BULLETIN No. 20, JULY, 1889.

COMMERCIAL FERTILIZERS, M. A. SCOVELL, M. S. (pp. 3–20).—This contains explanations of the uses of nitrogen, phosphoric acid, and potash as fertilizers, of the forms in which these materials are commonly found in commercial fertilizers, and of the analyses and valuations of such fertilizers. There are also a tabular record of analyses and valuations of seventy brands of fertilizers, legally on sale in Kentucky: the full text of the State fertilizer law; the rules and regulations for the sale and sampling of fertilizers, made by the director of the Station in conformity with the law; and advice to purchasers of fertilizers.

BULLETIN No. 21, SEPTEMBER, 1889.

EXPERIMENTS WITH WHEAT (pp. 3–15).—These included tests of varieties, methods of seeding, and fertilizers, and were mainly conducted on the Experiment Station farm, which is in the Blue-grass region, and has a light clay subsoil, retentive, and without proper drainage. The farm is, therefore, not especially adapted to wheat.

Tests of varieties (pp. 4–8).—This contains a tabular record of tests of forty-two varieties. The plats were small and were not duplicated, and the other conditions of the experiment were such as prevent the drawing of satisfactory inferences.

Methods of seeding (pp. 8, 9).—A brief preliminary report on a series of experiments with different methods of seeding wheat.

Field experiments with fertilizers on wheat (pp. 9–15).—These were conducted on soil of the character before described, the field being divided into tenth-acre plats separated by spaces 3 feet in width. The object was to learn whether fertilizers would be beneficial to wheat on this particular field, and if so, what essential ingredient or ingredients of the fertilizers were needed for this crop. Phosphoric acid in superphosphate, 300 pounds per acre; potash in sulphate (or muriate), 100 pounds per acre, and nitrogen as dried blood, 150 pounds per acre, were used singly, two by two, and all three together, two plats being left unmanured. The fertilizers were drilled in with wheat of the Penquite's Velvet Chaff variety. Throughout the fall growth of the crop there was a marked contrast in favor of the plats which received potash as compared with those which did not. This advantage largely disappeared at the time of blooming, though the potash plats still showed the thickest stand. A table of results at harvest shows little difference in the actual yields, thus apparently indicating that "this soil did not need fertilizers for wheat. Conclusions, however, should not be made from one year's trial, as the season may have a marked effect. These experiments will be continued from year to year on the same plats."

A series of plats used in field experiments with fertilizers on wheat for two years previous was again seeded in the autumn of 1888 with wheat of the Extra Early variety, to observe the effect of fertilizers remaining in the soil. "While the effect of the fertilizers is not well marked, it is still evident that there is a slight advantage in favor of the fertilized plats, and the yields of the last season show perceptibly the effects of the fertilizers applied in former years."

THE GRAIN LOUSE (SIPHONOPHORA AVENÆ), H. GARMAN (pp. 16-22).—This is a popular account of this insect and its enemies, published because of the great damage done to the wheat crop of this State by the grain louse in 1889.

BULLETIN No. 22, DECEMBER, 1889.

POTATO EXPERIMENTS IN 1889 (pp. 3-23).—A report of the continuation of experiments on the Station farm. "The soil on which all of our experiments are made is what is called a 'Blue-grass' soil. It is derived from the limestones of the Trenton group of the Lower Silurian. These limestones in general are rich in phosphoric acid. The subsoil of the farm is a light-colored clay, not easily permeable by water, and therefore the ground is generally wet and cold in the early spring. The soil is well worn by continued cultivation."

Tests of varieties (pp. 4-10).—Tabulated notes of growth and yield for 57 varieties, and of the dry substance, water, average weight of one potato, and specific gravity for each of 51 varieties.

Methods of planting (pp. 10-14).—(1) The trench system was compared with the usual method of planting for Early Rose and Burbank potatoes. (2) The yields from planting 14 and 20 inches apart in the row are compared.

Preparation of seed (pp. 14-16).—The yields are compared from planting northern grown seed of Early Rose on five small plats, as follows: Large potatoes, two eyes, cut in two, and whole; small, whole; medium, two eyes. The amounts planted per acre varied from 6 bushels of medium, cut to two eyes, to 48 bushels of large whole potatoes.

Field experiments with fertilizers (pp. 16-23).—Nitrate of soda, acid phosphate, and sulphate of potash, singly and in combination, and land plaster were compared with no manure on ten plats. The tabular records include data for the yield, profit or loss, and effect of the fertilizers on the quality of the product. Photo-engravings of the piles of potatoes harvested on each of six plats are given.

Summary of results (p. 3).—The conclusions which apply to this year's trials on the Station farm are briefly summarized below.

(1) Many new varieties produced a larger yield than either Early Rose or Burbank, notably Irish Wonder, producing 389; General Logan, 296; Lombard, 281; American Magnum Bonum, 280 bushels per acre, while the Burbank and Early Rose produced, respectively, 209 and 184 bushels per acre.

(2) The trench system of planting produced no marked effect as to the yield over the usual method of planting. The yield was greater for forty-eight out of fifty-five varieties where potatoes were planted 14 inches apart in the row than where planted at intervals of 20 inches. On the contrary, the proportion of large to small potatoes was in favor of the 20-inch planting.

(3) Planting large whole potatoes largely increased the yield over planting potatoes cut to two eyes, or cut in two, or small whole potatoes. The yield was in direct ratio to the weight of seed potatoes planted. The profit in planting large whole potatoes depends largely upon the season and prices of seed and of harvested crops.

(4) The yield was largely increased by the use of fertilizers containing potash. Where fertilizers containing no potash were used there was little increase of yield. In every case where potash was used the increase was large. The largest yields were obtained when potash was supplemented by acid phosphate and nitrate of soda.

(5) A profit was uniformly obtained by applying fertilizers in which potash was one of the ingredients; the largest profit came when phosphate and nitrate were used with the potash salt.

"In general, the conclusions reached this year as to the methods of seeding and the effects of fertilizers agree with those obtained last year, although the seasons were unlike. The results of two years' trials, therefore, would lead us to believe that it is potash which is most needed to enrich the soil of the Experiment Station farm for the production of potatoes. They indicate but do not prove that worn soils of the same class in the Blue-grass region would also be improved by the application of potash. This can be determined positively, however, only by similar experiments on the various farms."

LOUISIANA.

No. 1. Sugar Experiment Station, Audubon Park, New Orleans.
No. 2. State Experiment Station, Baton Rouge.
No. 3. North Louisiana Experiment Station, Calhoun.

Department of Louisiana State University and Agricultural and Mechanical College.

Director, William C. Stubbs, Ph. D.

BULLETIN No. 24 (STATE STATION).

RICE AND ITS BY-PRODUCTS, W. C. STUBBS, PH. D. (pp. 364–373).—An introductory article containing notes on an unsuccessful experiment with fertilizers on rice in continuation of those reported in Bulletin No. 15 of this station, and on the processes of rice milling and the chemistry of its products.

COMPOSITION OF RICE AND THE VARIOUS PRODUCTS OF THE RICE MILLING PROCESS, B. B. ROSS, M. S. (pp. 374-389).—* Samples representing the products of rice at the different stages of the milling process were obtained from one of the principal milling establishments of New Orleans and analyzed at the Station. The samples included "rough rice" (as shipped from the plantation), "rice from the stones," "pounded rice," bran, "rice from the cooling floor," "polish," cleaned milled rice, and hulls. Rice straw, obtained from another source, was also analyzed. The methods and results of analysis are explained. The digestibility of the albuminoids was estimated by treatment with pepsin solution. The absolute and relative quantities of the proximate constituents in the samples analyzed are given, and the results of analysis of the air-dried and water-free substance are stated in tables.

BULLETIN No. 25 (STATE STATION).

ANALYSES OF COMMERCIAL FERTILIZERS AND OTHER SUBSTANCES USEFUL TO AGRICULTURE, W. C. STUBBS, PH. D. (pp. 391-417).—This includes reports on the analyses of forty-seven different kinds of commercial fertilizers, besides limestone, marl, "gluten meal," guano, water from an artesian well, and bituminous coal. The samples were selected by the Commissioner of Agriculture, or by the purchaser, under regulations prescribed by the Commissioner or by the Station; or were sent to the Station by private parties. The full text of the fertilizer law and popular explanations of the ingredients and valuations of commercial fertilizers are given, together with descriptions of the samples analyzed and tabular records of the analyses. "The demand for fertilizers during the last season has decidedly increased. The general character of the article offered for sale has been fairly within the guarantee given."

> Under the fertilizer law every citizen of the State is amply protected from fraud and imposition by unscrupulous dealers, and there exists absolutely no cause for distrust in the purchase of commercial fertilizers, if the farmer will but claim the protection afforded him. The sellers of good wares are also protected, as ample facilities are afforded them of properly advertising their goods.

It is also stated that cotton-seed meal is largely used as a fertilizer in all parts of Louisiana, being considered the cheapest and best source of nitrogen, and that the use of tankage is increasing.

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* See König's Nahrungs- und Genussmittel, Dritte Auflage, Bd. 1, S. 569 ff., for some forty analyses of the grain of rice with and without the hulls, from Europe, Asia, Africa, and America, and three of "glutinous rice" *(Oryza glutinosa)*.

MARYLAND.

Maryland Agricultural Experiment Station.

Department of Maryland Agricultural College.
Location, Agricultural College P. O. Director, Henry E. Alvord, C. E.

SPECIAL BULLETIN (FAIR EDITION), 1889.

Facts about the Station, Henry E. Alvord, C. E. (pp. 3–8).—This was published for distribution at agricultural fairs and contains a brief account of the duties, work, and publications of the Station as conducted under the act of Congress of March 2, 1887, together with a schedule of the field experiments in progress in 1889, and a summary of the varieties of orchard and small fruits, grasses, field crops, and vegetables grown at the Station in the same year.

MASSACHUSETTS.

Massachusetts State Agricultural Experiment Station.

Location, Amherst. Director, Charles A. Goessmann, Ph. D.

BULLETIN No. 35, NOVEMBER, 1889.

Meteorological summary (p. 1).—For the five months ending October 31, 1889.

Feeding experiments with milch cows, C. A. Goessmann, Ph. D. (pp. 2–12).—This is a summary of feeding experiments begun at the Station in November, 1885, with special reference to those conducted in 1889. More detailed accounts of the earlier experiments will be found in the annual reports and bulletins of the Station previously published. The object of these experiments was to get information on the following points:

(1) The *total* and *net* cost of the daily ration per head with the different combinations of feeding stuffs used. The net cost was estimated by assuming that 20 per cent of the fertilizing ingredients of the food would be sold with the milk, assigning a manurial value to the remaining 80 per cent supposed to be saved, and subtracting the value of manure computed on this basis from the total cost of food.

(2) The commercial value (on the assumption above stated), at current market rates, for nitrogen, phosphoric acid, and potash, of the manure from the different combinations of feeding stuffs used, which can be secured to the farm by careful management.

(3) The comparative feeding value of dry fodder corn, dry corn stover, and corn silage as complete or partial substitutes for English hay (upland meadow hay) in the daily diet of milch cows; and also of a good root crop as a substitute for corn silage.

As indicated in a tabular summary, the experiments were divided into four series:

Series 1: With two cows, from November 20, 1885, to July 4, 1886.

Series 2: With three cows, from October 1, 1886, to April 24, 1887.

Series 3: With six cows, from January 8, 1888, to May 15, 1888.

Series 4: With nine cows, from November 1, 1888, to May 21, 1889.

The feeding stuffs used were corn meal, wheat bran, gluten meal, rye middlings, fodder corn, English hay, rowen, corn stover, corn silage, sugar-beets, and carrots. During the first series corn meal and wheat bran or wheat bran alone served as the grain ration; in the other series, as a rule, corn meal, wheat bran, and gluten meal were fed. The daily rations fed, including fourteen mixtures of the above-mentioned feeding stuffs, together with their total and net cost, nutritive ratios, and manurial values, are given.

Net cost of feeding stuffs.—This is estimated by subtracting the value of the nitrogen, phosphoric acid, and potash in the manure obtainable from particular feeding stuffs from the market value of the same feeding stuffs. It should be remembered in this connection that the prices of corn meal, wheat bran, oil cakes, gluten meal, and similar by-products are much more variable than those of the coarser fodders, such as English hay, corn stover, and corn silage. This makes it necessary for farmers to carefully consider what kinds of fodder they will use from time to time and to make such changes as are advised by the relative net cost of various feeding stuffs. The following table gives the average valuations at the Station of the feeding stuffs used in the experiments summarized in this bulletin (1885–89):

Fodder articles used during our feeding experiments (1885 to 1889).

Name of article.	Market price.	Value of manurial constituents.	Relative net cost.
	Per ton.	*Per ton.*	*Per ton.*
English hay	$15.00	$5.58	$10.54
Rowen (dry)	15.00	9.83	7.14
Fodder corn (dry)	5.00	4.53	1.38
Corn stover (dry)	5.00	3.21	2.43
Corn silage	2.75	1.56	1.50
Corn meal	21.90	6.51	16.69
Wheat bran	20.70	13.64	9.79
Gluten meal	23.40	15.23	11.22

Nutritive value of feeding stuffs.—While the financial value of feeding stuffs is regulated by the general law of supply and demand, their feeding value depends on varying conditions, often more or less beyond our control. These relate to the composition of the feeding stuffs and the proportions in which they are combined in the rations, and to the condition and age of the animals fed. In seeking an economical diet for live stock "both the net cost of the feed and its relative nutritive or feeding effect under existing circumstances" have to be taken into account.

The economy of milk production in particular has received much attention. European investigators recommend in this connection quite generally a daily diet, rich in digestible nitrogenous constituents, as beneficial to the general condition of cows, at the same time reducing the net cost of the feed consumed and furnishing valuable homemade manure at the lowest market cost. The European standard for a daily diet of milch cows calls for one part of digestible nitrogenous fodder constituents to five and four-tenths parts of digestible non-nitrogenous food constituents. Our results on the whole point in the same direction. The nitrogenous food constituents of the fodder rations received special attention.

In the experiment reported in this bulletin the main subject of inquiry related to the effect of the partial or complete substitution of corn fodder, corn stover, or corn silage for English hay on the net cost of the feed and the quality and quantity of milk produced.

The percentage of solids and fat in the milk and cream produced during different periods in 1888 and 1889, and the average number of quarts of milk required to make one space of cream during different periods are given in tables.

Conclusions.—From the financial standpoint it is shown that wherever fodder corn, corn stover, or corn silage were fed as a complete or partial substitute for English hay, in connection with a stated grain ration, the commercial value of the manure obtainable was affected slightly if at all, while the *net cost* of the daily feed was reduced from one-third to one-half.

"The partial abstracts from the milk and creamery records show that the fodder corn, corn stover, and corn silage, when fed pound for pound of dry matter in place of English hay, compare well as far as the quality and the quantity of the milk and of the cream obtained is concerned.

"There can be no doubt about the fact, in the present condition of our market prices of feed stuffs, that the care and the expense required to secure a well-cured corn fodder and corn stover or a well-prepared corn silage, as circumstances may advise, and to offer them in an acceptable form to milch cows will prove a paying investment.

"It may not be without interest to state here that the results of feeding experiments of a similar character, of late published by the Ohio and Iowa Experiment Stations, coincide in the main with ours stated in previous reports."

Hatch Experiment Station of the Massachusetts Agricultural College.

Department of the Massachusetts Agricultural College.

Location, Amherst. Director, Henry H. Goodell, M. A.

BULLETIN No. 5, JULY, 1889.

HOUSEHOLD PESTS, C. H. FERNALD, PH. D. (pp. 3-10).—This was prepared in response to numerous inquiries received at the Station, and contains popular accounts of the buffalo carpet beetle (*Anthrenus scrophulariæ*, Linn.), pitchy carpet beetle (*Attagenus piceus*, Oliv.), larder or bacon beetle (*Dermestes lardarius*, Linn.), clothes moths (*Tinea tapetzella*, and *T. pellionella*, Linn.), and ants, with suggestions regarding remedies.

BULLETIN No. 6, OCTOBER, 1889.

Greenhouse heating—steam versus hot water. S. T. Maynard, B. S. (pp. 3–5).—This is a report on the continuation of an experiment described in Bulletin No. 4 of this Station, and includes the record of the two systems of heating greenhouses for March and April, 1889. The results agree with those of the two previous months. During the four months from December 23, 1888, to April 24, 1889, the hot-water boiler consumed 4 tons 1,155 pounds of coal to maintain an average temperature of 53.5° F.; the steam boiler consumed 5 tons 1,261 pounds of coal to maintain an average temperature of 51.2° F.

Strawberries—test of varieties. S. T. Maynard, B. S. (pp. 6–8).—A record of tests of seventy-seven varieties, with additional notes on a few selected varieties. The old varieties which did the best in 1889 are Crescent, May King, Sharpless, Belmont, and Miner's Prolific; of the varieties which have been tested here two or three years, Jessie, Buback, and Gandy's Prize are especially commended. It is stated that the market demands large berries even at the expense of quality, and that many growers have not yet learned that such fruit can be grown only with the highest cultivation.

Fungous diseases of plants. J. E. Humphrey, B. S. (pp. 9–19).—This includes general explanatory statements regarding fungi and the means for their destruction or prevention, and brief accounts of the black spot of rose leaves (*Actinonema rosæ*, Fr.), black knot of the plum (*Plowrightia morbosa*, Sacc.), and potato blight and rot (*Phytophthora infestans*, de By.), with suggestions as to remedies.

METEOROLOGICAL BULLETINS Nos. 1–12, JANUARY–DECEMBER, 1889.

These contain a record of the observations made at the meteorological observatory of the Station, in charge of C. D. Warner, including daily observations of the barometer, sun thermometer, hygrometer, thermometer, direction and velocity of the wind, cloudiness, rain, and snow. A monthly summary of these observations is also given in each bulletin.

SPECIAL BULLETIN, NOVEMBER, 1889.

The Gipsy moth (Ocneria dispar, L.). C. H. Fernald, Ph. D. (pp. 3–8).—This contains an illustrated description of this insect, suggestions as to its destruction, a list of trees and plants on which it feeds, an account of its introduction into this country, and statements which indicate the danger of its spreading widely here. This insect was accidentally introduced into this country about twenty years ago, and is now acclimated in Medford, Mass., where it has greatly damaged the fruit crop and the foliage of the shade trees. It is abundant in nearly all parts of Europe, Northern and Western Asia, and even as far east as Japan. When the long list of trees and plants on which it feeds is considered, the prospect of its wide spread in this country would naturally cause serious alarm. Prominent European entomologists have expressed the opinion that the Gipsy moth might easily become a worse pest in this country than the Colorado potato beetle. The eggs are globular, about one-eighteenth of an inch in diameter, smooth, and nearly salmon colored. They are laid in oval or rounded masses on the under side of branches, on trunks of trees, below the surface of the ground near trees, on fences, or on the sides of buildings, in the early part of July, but do not hatch until spring. The caterpillars, which are very dark brown or black, finely reticulated with pale yellow, feed together on the leaves, or rest side by side on branches and trunks of trees. The moths, which emerge from the pupæ from July 1 to 15, are yellowish brown or white, with dark brown cross lines and spots of similar color on the wings. The expanse of wings is from 1½ to 2¾ inches. The insects might be destroyed by scraping all the masses of eggs from the trees and other places where they have been deposited, and burning them. As it seems hardly possible to do this, Professor Fernald recommends that all the trees in the infested region be showered with Paris green water (1 pound to 150 gallons) soon after the hatching of the eggs in the spring. If this recommendation is followed promptly wherever the insect appears it may be destroyed without great labor or expense.

[It may be added that the subject is to be brought to the attention of the State legislature for appropriate action.—EDITOR.]

MICHIGAN.

Experiment Station of Michigan Agricultural College.

Department of Michigan Agricultural College.

Location, Agricultural College.   Director, Oscar Clute, M. S.

BULLETIN No. 51 (STATION), JULY, 1889.

ENEMIES OF THE WHEAT APHIS, A. J. COOK, M. S. (pp. 3–7).—This was written in response to numerous inquiries from farmers who feared that the insects which destroyed the wheat aphis would also complete the destruction of the crops, begun by the aphis. In order to remove this fear illustrated descriptions are given of the Braconid fly, lady-bird beetles, Syrphus fly, and Chrysopa fly, and the ways in which they destroy the wheat aphis are described.

BULLETIN No. 52 (STATION), JULY, 1889.

COMMERCIAL FERTILIZERS, R. C. KEDZIE, M. D. (pp. 1–7).—This contains the analyses of thirty-two commercial fertilizers offered for sale in this State during 1889, and the text of the Michigan fertilizer law. Under this law "every fertilizer whose retail price exceeds $10 a ton requires a license from each dealer, unless the manufacturer secures a license for such sale. Each separate brand of fertilizers requires a license for each year it is sold or offered for sale." The analyses of fertilizers were made by Dr. Kedzie as the duly authorized agent of the State Board of Agriculture.

BULLETIN No. 53 (STATION), AUGUST, 1889.

SPRAYING WITH THE ARSENITES, A. J. COOK, M. S. (pp. 3-8).—*Insecticides for the plum curculio.*—After several years unsuccessful experience the author succeeded, in 1888, in securing good results from spraying Paris green on plum trees to destroy curculio. In this case the trees were sprayed three times at intervals of eight days. The poor results of previous experiments are thought to have been due to want of thoroughness. In the dry season of 1888 carbolized plaster (1 pint of crude carbolic acid to 50 pounds of plaster), applied three times, was found quite as efficient as the arsenites to repel the curculio, but in the wet season of 1889 the plaster proved of no avail. The author draws the following conclusions from his experience: "The arsenites and carbolized plaster will protect against the plum curculio if they can be kept on the tree or fruit. But in case of very frequent rains the jarring method will not only be cheaper but much more effective. Again, as our wild fruits are more cleared away we must have plums in our orchards to protect the apples from curculio." It is urged that these insecticides should not be applied before the blossoms fall lest bees may be destroyed by the poisons.

Injury to foliage by arsenites.—Here is given a tabulated record of experiments on plum, cherry, apple, pear, peach, willow, elm, and maple trees, in 1889, to learn the effects of different arsenites on foliage and whether the date of treatment and atmospheric conditions have any influence on the amount of such injury. The following conclusions are drawn from this experiment:

"London purple is more injurious to the foliage than is Paris green; and white arsenic—arsenious acid—is more harmful than is either London purple or Paris green.

"Peach foliage is especially susceptible to injury, and cherry foliage the least so of any of the kinds treated.

"It would seem that London purple and white arsenic, used just before a rain, are more harmful than when used during a drought.

"It would seem that spraying soon after the foliage puts out is less harmful than when it is delayed a few days, or better, a few weeks.

"London purple may be used on apple, plum, cherry, pear, and most ornamental trees, but on these should never be stronger than 1 pound to 200 gallons of water. If the application is to be repeated, as it must be for the curculio, to prove effective, or if it is to be used in June or July, Paris green should be used in the same proportion as above, or else we should only use 1 pound of London purple to 300 gallons of water.

"If the arsenites are to be used on the peach to defend against the curculio, Paris green only should be used, and that not stronger than 1 pound to 300 gallons of water.

"The injury done to the foliage is never immediately apparent. It usually shows somewhat the second day, but the full injury is frequently not manifest till the fifth day, and often not till the tenth."

Poisoning the pasture under the trees.—Experiments with seventy-five hogs, three sheep, and one horse running under trees which had been sprayed with London purple, confirmed the results of chemical analyses in showing that there is no danger of poisoning the pastures in orchards even when the mixtures of arsenites used are double the proper strength.

BULLETIN No. 54 (STATION), OCTOBER, 1889.

EXPERIMENTS AND OBSERVATIONS ON THE JACK-PINE PLAINS, W. J. BEAL, PH. D. (pp. 3–10).—The importance of the problems connected with the reclamation of the pine barrens in the northern part of Michigan has been referred to in previous publications of the Station and this Office.* The present bulletin contains a preliminary report of experiments made at several places within this region. From the tests of numerous kinds of crops made at Grayling and at Harrison, added to what has been learned from many other sources, the author sees no present prospect of finding "any grass or other forage crop, any grain or fruit or vegetables, which can be profitably grown on these plains without the aid of some fertilizer."

Notes on experiments in 1888–89 at Walton are given, and these tests are compared with those made at other places. The author also gives the results of his observations and experiments in the management of light, sandy lands. He advises the use of mixtures of three or more kinds of grasses and clovers as occupying the soil more completely and giving a better yield than any one kind used alone. In his opinion the best varieties for this purpose are Mammoth clover, alsike clover, tall oat grass, orchard grass, tall fescue, and *Agropyrum tenerum* (a wild grass from the West). Some fertilizer should be added every year, especially all the available barn-yard manure, and probably superphosphate for clovers. It is believed that successful agriculture on the sandy plains depends upon generous treatment of the soil, and that these lands can be reclaimed only by men who have sufficient capital to be able to wait for a considerable time before seeing the results of their labors.

BULLETIN No. 55 (STATION), DECEMBER, 1889.

FRUIT TESTING AT THE SOUTH HAVEN SUBSTATION, T. T. LYON, (pp. 4–32).—"In response to the earnest requests of the fruit growers along the eastern shore of Lake Michigan the Board of Agriculture authorized the establishment of a substation for the purpose of testing the value of new varieties of fruit in that section." The extensive experimental plantations of the author at South Haven were used, and he has embodied the results of his observations during the season of 1889 in the report contained in this bulletin. Tests were made with one hundred and eight varieties of strawberries, forty-four of raspberries, and twenty-three of blackberries. The data recorded in tables include, for the plant, sexuality, place and time of origin, dates of earliest bloom, first ripe fruit, and last picking, vigor, hardiness, productiveness, and damage by fungi: for the fruit, size, quality, firmness, form, and color. There are also brief remarks on each variety and longer notices of varieties thought worthy of special mention. The article contains brief notes on a considerable number of varieties of other fruits planted on these grounds, including currants, gooseberries, cherries, grapes, peaches, pears, plums, quinces, apples, and mulberries, together with chestnuts, pecans, and English walnuts.

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* See Annual Report of Michigan Station for 1888, a digest of which is given in Experiment Station Bulletin No. 2 of this Office, pages 94–105.

MINNESOTA.

Agricultural Experiment Station of the University of Minnesota.

Department of the University of Minnesota.

Location, Saint Anthony Park. Director, N. W. McLain, LL. B.

BULLETIN No. 8, JULY, 1889.

Introduction, N. W. McLain, LL. B. (pp. 3, 4).—Attention is called to the school for meat inspectors, organized by the director of the Station, and put in charge of the Station veterinarian, in which thirty-four men from different counties of the State were given practical instruction, illustrated by slaughtering and dissection of diseased animals, in such topics of veterinary science as would qualify them to " inspect on the hoof." At the end of the course certificates of qualification as meat inspectors were given to twenty-one of these students, who had passed a written and oral examination.

Ensiling clover, N. W. McLain, LL. B. (pp. 5–7).—This is a preliminary report on an experiment in progress at the Station to get additional information on this subject. The importance of the matter is urged, the silo built at the Station is described, the method of filling the silo, and the temperature of the silage at different depths and dates are stated, and the successful experience of a Kansas farmer in an experiment with this kind of silage quoted.

Sources of our home-made manures, W. M. Hays, B. S. A. (pp. 8–11).—This is an earnest plea to Minnesota farmers to engage in more diversified farming, and to keep up the wheat-producing power of their lands by rotation of crops and the use of manures. A table is given " showing the annual production in Minnesota of the principal grains, meats, by-products, etc.; their content of the three principal fertilizing ingredients, nitrogen, phosphoric acid, and potash; their value per ton, reckoned at prices in New York and Boston; and their total and comparative value as fertilizers." Attention is called to the lack of appreciation of the value of flaxseed for feeding and manure. Of the 16,000 tons of oil-cake made at two large mills in Minnesota, it is stated that 4 per cent is fed in the State, 4 per cent in other Northwestern States, and 92 per cent is shipped to England. By stopping "the exportation of so much of the fertility of the soil," condensing products "into meat, butter, cheese, flour, etc., as near the farm as possible," using oats, barley, and all the by-products of grain for feed and manure, stopping the waste of all manurial substances, and rotating wheat with grass, peas, and other forage crops, wheat may be grown as the principal money crop of this section.

THE BY-PRODUCTS OF WHEAT, W. M. HAYS, B. S. A., AND D. N. HARPER, PH. D. (pp. 12–16).—The growing demand for the by-products of wheat as food for animals is commented on and the necessity for care in making a choice among the different products of the mills is urged. Chemical analyses of various by-products of wheat obtained from Minnesota mills are given in tabular form and compared with similar analyses of oats, shorts, bran, and clover hay. To avoid confusion the following definitions are given:

> The name *screenings* has been herein used for the waste products cleaned out of wheat, *screenings meal* for the same when ground; *cockle bran* for the bran of small wheat and hulls of weed seeds, after running ground screenings through the "reel" and removing the finer floury particles which are put into the shorts, and here called *flour of screenings*. The tables show that the composition of an average sample of screenings differs but little from that of oats, and practical experience indicates that good average screenings have nearly an equal feeding value for many purposes. The flour of screenings is shown to have considerable less of protein than shorts, and therefore adding it to the shorts slightly decreases the value of the shorts for mixing with coarse, rough fodders which need to be supplemented with feeds especially rich in protein. Even the better grades of cockle bran, owing to a large proportion of wheat bran contained, have a value approaching that of hay. These products should all be fed in the country producing the wheat, because of their value in feeding animals and for fertilizing the land.

THE ROCKY MOUNTAIN LOCUST IN OTTER TAIL COUNTY, MINN., IN 1889, O. LUGGER, PH. D. (pp. 17–36).—This is an account of an extensive experiment in the spring of 1889 by the entomologist of the Station and the chairman of the county commissioners of Otter Tail County, acting under the authority of the governor of the State, in accordance with the provisions of an act of the legislature. As previously stated in the annual report of the Station for 1888, "no locusts had issued in that year from eggs in fields plowed after such eggs had been deposited." To make quite sure of the correctness of this observation, numerous plowed fields were investigated very closely in the spring of 1889, but in no case could a single egg-mass be found near the surface, and subsequent observations showed that no locusts hatched from such fields. On the other hand, a close inspection of neglected or abandoned fields revealed the fact that fields with the stubble of 1888 contained large numbers of eggs, while the stubble land of years previous to 1888 contained either no eggs or very few. No eggs could be found in the native prairie land, and but few in pastures or along roads and railroads. It was also shown that essentially the same area as in 1888 was infested.

In some fields as many as 75 per cent, or even more, of the eggs had been destroyed by parasites, and in general throughout the whole infested area it is safe to say that at least one-half of all the eggs had been destroyed, principally by egg-feeding insects. An illustrated description of the eggs of the locusts and the way in which they are deposited in the fields is given. By plowing the infested field the eggs are removed from the surface and covered with 5 or 6 inches of soil, and the position of the burrow or hole containing the egg-mass is inverted, so that its mouth points downward instead of upward. Plowing has this additional advantage, that the egg-masses in most cases are thus thoroughly broken up, individual eggs become surrounded by earth and moisture, and being no longer protected by their water-proof coat of dried mucous matter they soon perish.

Methods employed to kill the locust.—(1) *Plowing.*—This was the method most extensively employed in this case, and proved a great success. Notwithstanding the fact that the natural conditions were favorable to the locust, none hatched in plowed fields. As it was found impracticable to plow all the infested fields in time to prevent the eggs from hatching, the worst places were plowed first and afterwards those that were less thoroughly infested, together with some timothy fields and pastures. A large portion of this work was done at the expense of the State. (2) *Burning.*—In many places where the eggs were not numerous enough to warrant plowing the entire field, a strip was plowed around the field and the inclosed space was burned over after the young locusts appeared. (3) *Catching with hopper-dozers.*—These were used with success in timothy fields and pastures where the locusts had hatched. (4) *Rolling.*—This method was tried in several instances by farmers without success. (5) *London purple.*—This material was used as an insecticide for the locust in several cases with marked success.

An examination of soil from some of the plowed fields in July showed that either the eggs were destroyed or, if they had hatched, the young locusts had died before reaching the surface.

The parasitic and predaceous insects mentioned in the annual report of the Station for 1888 as feeding on the eggs of the locust were equally abundant in 1889. Those mentioned in this bulletin are the red mite (*Trombidium locustarum*), bee fly (*Syntœchus oreas*), blister beetles, a click-beetle (*Cryptohypnus bicolor*, Esch., var. *lacus-*

tris), hawk fly (*Erax bastardii*), also a new species of *Scelio*, egg-feeding beetles of the genus *Amara*, larvæ of *Harpalus herbivagus*, Say (?), Tachina flies, and flesh flies.

During the early summer of 1889 at least twenty species of locusts occurred in large numbers throughout Otter Tail County and other parts of Minnesota.

The need of additional legislation and of prompt, intelligent, and concerted action by farmers is emphasized.

BULLETIN No. 9, NOVEMBER, 1889.

RUSSIAN WILLOWS AND POPLARS, S. B. GREEN, B. S. (pp. 39–47), (illustrated).—In this are given descriptions of eleven species of poplars and six species of willows from Europe and Asia, which have been grown at least five years in this State, with suggestions as to their value for Minnesota. These trees may be used for wind-breaks, timber, shade, ornaments, etc. In an experiment in growing cuttings from these varieties in the spring of 1888, over 80 per cent of the cuttings from all except three varieties rooted. Persons desiring to plant cuttings are advised to select clean two-year-old wood, or strong, well-ripened one-year-old wood from healthy, vigorous trees. Pieces 8 to 10 inches long and about one-half an inch in diameter are preferred. "It is generally best to make cuttings in the fall after the growth stops," but they may also be rooted successfully if made early in the spring. They should be planted in mellow soil, at least 8 inches deep, in rows 3 feet apart.

INSECTS AFFECTING POPLARS AND WILLOWS, O. LUGGER, PH. D. (pp. 48–64), (illustrated).—This contains popular accounts of the large willow saw-fly (*Cimbex americana*), yellow-spotted willow slug (*Nematus ventralis*), streaked cotton-wood leaf beetle (*Lina scripta*), *Lina tremulæ*, *Lina lapponica*, poplar borer (*Saperda calcarata*), poplar girdler (*Saperda concolor*), Antiopa butterfly (*Vanessa antiopa*), fall web worm (*Hyphantria cunea*), Cecropia moth (*Platysamia cecropia*), and American silkworm (*Telea polyphemus*). A Tachinid fly was observed to attack the large willow saw-fly. As stated in Insect Life, Vol. II, p. 164, "the work of the poplar girdler is for the first time illustrated, and a number of different species of Ichneumonidæ are reported to have been bred from it. *Acronycta populi*, Riley, is made a synonym of *A. lepusculina*, Guenée, following Grote; but this is an error, the latter species, known to us, being different in both larva and imago, and occurring on the Pacific coast."

MISSISSIPPI.

Mississippi Agricultural Experiment Station.

Department of Mississippi State Agricultural College.
Location, Agricultural College. Director, S. M. Tracy, M. S.

BULLETIN No. 8, AUGUST 30, 1889.

STOCK FEEDING, B. IRBY, M. S. (pp. 1–9).—*Silos and silage.*—The silos in use at the Station are described, and analyses of corn, sorghum, pea vines, teosinte, and chicken corn (*Sorghum vulgare*) used for silage are given.

Chicken corn vs. corn as food for mules.—A brief account of an experiment in which chicken corn was compared with corn as a partial ration for mules. Analyses of these two feeding stuffs and "mixed hay" are given.

Feeding experiments with calves.—Twenty-one grade Holstein and Jersey calves, divided into seven lots of three each, were fed eight weeks to compare different feeding stuffs, of which the cheapest in this case appeared to be cotton seed.

BULLETIN No. 9, AUGUST 30, 1889.

SOME ENTOZOIC DISEASES OF SHEEP AND CALVES, D. L. PHARES, M. D. (pp. 3–10).—This contains brief popular accounts of some of these diseases, with suggestions as to treatment and prevention, and diagrams of parasites causing such diseases.

HELENIUM AUTUMNALE, D. L. PHARES, M. D. (pp. 11–14).—Brief notes on experiments with three calves, showing the poisonous effects of decoctions of this weed, which sometimes is very harmful to animals out at pasture. The flower and leaf of the plant are illustrated in diagrams accompanying the article.

BULLETIN No. 10, OCTOBER 10, 1889.

DEHORNING, D. L. PHARES, M. D. (pp. 3–13), (illustrated).—The author thoroughly believes in the usefulness of dehorning cattle, and considers it neither a dangerous nor a cruel operation. He states that he has been long familiar with it, and that during the last three years he has examined cases and reports of cases to the number of more than 10,000. The bulletin gives popular explanations of the anatomy of the head of the ox, directions for performing the dehorning and for treatment in case of hemorrhages, and considerations which make dehorning advisable. Sections of horns are illustrated by diagrams.

The author seems to especially favor the dehorning of calves, though he thinks that it "may be performed on animals of any age, with little danger of serious injury."

At the place where the horn is to come the young calf has a small, button-like, hairless spot, easily seized and moved with thumb and fingers. After a few weeks a small tubercle may be felt under the skin; now absorption has commenced on the inside, extending the frontal sinus, and deposit is taking place outside under the skin, and a core for the horn has commenced forming. Now is probably the best time to dishorn, and a pocket-knife or scalpel is a convenient instrument for performing the operation. The bald skin with a border of one-fourth of an inch wide of hair-covered skin, together with the cartilaginous button or tubercle beneath, may all be easily severed with a single cut and in a moment. But a few drops of blood are lost, the periosteum which secretes the bony core and the portion of skin which secretes the horn are removed with little pain to the calf and in a few days it is well.

The beneficial results of dehorning are recapitulated as follows:

It prevents these animals from wounding and bruising and famishing one another, saves a vast amount of time in handling, of room in sheltering, and of feed stuff. Beeves are fatted for market with much less expense of feed and in less time. They go into the markets, as attested by the dealers at the great cattle depots, in much better condition, having whole hides and unbruised flesh, both of which sell more promptly and at better prices, while the cost of transportation of the live animals is much less, because a larger number can be packed in each car. For like reasons the milk, cream, and butter product is increased in quantity and improved in quality.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE ISSUED IN 1889.

PART III.

DIVISION OF CHEMISTRY.

BULLETIN No. 21.

Experiments in the manufacture of sugar by diffusion at Lawrence, La., in 1888–89. G. L. Spencer (pp. 67).—This contains a description of the apparatus and processes employed, and details of works and results. The diffusion battery used was of the type ordinarily employed in the extraction of sugar from the cane, and had a capacity of about 200 tons of cane per day. The text and tables show the quality of the cane, as indicated by analyses of the normal juice and of the corresponding diffusion juices, yields of sugar, amount of coal consumed, manufacturing data, and numerous other details.

Summary.—The results of the diffusion work thoroughly demonstrate the practical manufacturing value of the process as applied to sugar cane. The cane will submit to rougher treatment in the diffusion battery than the beet, and consequently the manipulations are simpler. This very property of the cane often tempts the batterymen to careless work, resulting in loss to the planter. Every possible precaution should be taken to secure regularity of work. It should be remembered that the batteryman is placed in a responsible position, and he should be remunerated accordingly.

Delays incident to the diffusion battery were of rare occurrence. With satisfactory cutters there is very little probability of delays except from bad weather.

The results of this season's work indicate the possibilities of diffusion and justify a rapid introduction of the process.

BULLETIN No. 22.

Experiments at Des Lignes Sugar Experiment Station, Baldwin, La., in 1888. C. A. Crampton (pp. 36).—The equipment of the factory and the method of its operation are described. The results for each week are summarized and compared. There are also tables of the daily analyses of juices from the mills, with an average for the four weeks during which the factory was under complete chemical control; manufacturing data, including the tons of cane grown and the amount of merchantable sugar made; the amount of sugar recovered in the different products and in the molasses, and the percentage of this sugar in terms of the cane and of the sucrose in the original juice; the losses which occurred in the manufacturing operations of the house: the loss by inversion, calculated for each operation, and the results of inversion. It appears from these tables that the total loss in the house was 8.03 per cent of the amount of sugar present in the juice, which was taken as a starting point.

Experiments in acid and neutral clarification of the juices resulted in showing that neutral clarification, while involving some damage to the quality of the final product, avoids most of the loss by inversion, which occurs when the juices are kept acid. The loss by inversion due to boiling and skimming the sirup in open evaporators, as is the custom in many sugar-houses, was plainly demonstrated by a series of comparative tests.

Experiments in the use of maceration between mills gave important results. With a dilution of about 10 per cent the extraction was improved fully 5 per cent over that ordinarily obtained by the mill; or, in other words, the yield of sugar per ton of cane was increased at least 10 pounds.

To find whether cane improves by standing in the field, analyses of cane taken from different fields at the beginning of the season were compared with those of cane taken from the same fields at the end of the season. It was found that an improvement equivalent to from 13 to 23 pounds of available sugar per ton had taken place in the cane allowed to stand the longest.

The proprietors of the plantation intend to adopt diffusion for the coming campaign. Arrangements have been made by which the Department of Agriculture will have control of the chemical work and will issue a report of the season's operations.

BULLETIN No. 23.

EXPERIMENTS AT THE SUGAR EXPERIMENT STATION ON CALUMET PLANTATION, PATTERSONVILLE, LA., IN 1888–89, H. EDSON (pp. 42).—" The factory is located on the bank of the Bayou Teche, 4½ miles above Patterson, parish St. Mary, La., and has, therefore, an unlimited supply of water, well adapted to every sugar-factory purpose." The plant of the factory, its organization and administration, and the processes of manufacture are described. An account is also given of the operations of the season, with details, in tabular form. By the addition of 11.94 per cent of water when the cane was macerated, 17 pounds of sugar per ton were gained. " The only extra expense entailed was that involved in the evaporation of the water added, and as at Calumet all the exhaust steam could not be used before maceration was begun, the extra yield was secured with almost no expense."

Available sugar.—A table gives the results of each of the five runs into which the campaign was divided at Calumet, including both the amount of sugar according to the regular formula and that which was actually secured; also a formula expressing the results. The yield is the best ever obtained in Louisiana by the milling process.

Neutral vs. acid clarification.—The different methods of clarification and the prices are discussed. "In all Louisiana sugarhouses where sulphur is used the juices are left slightly acid for the purpose of securing an improved color in all the products, from first sugar to final molasses, inclusive. This practice is followed both in open-kettle and vacuum-pan sugarhouses. * * * As far as this season's work was carried at Calumet the advantage lies entirely with the acid clarification. By careful and expeditious working of the juice inversion was almost prevented; as large an amount of sugar can be recovered from the juice and the market value of the products are invariably higher."

As the result of the season's work, the average total sugar obtained per ton of the whole crop of cane was 206.85 pounds. "From the sirup to the final product it is hard to see how the work could be improved. The most noticeable feature, and the one, I think, to which the high yield may be attributed, was the remarkable stiffness to which the massecuites were boiled. In all grades of the material as much water was driven off as was thought safe to do. By this remarkably good boiling an amount of sugar was recovered which leaves absolutely no room for comparison with the work of other Louisiana sugarhouses. * * * What has been done can be done again, and when the Louisiana planter adopts diffusion, and carries his sugarhouse work to such a degree of perfection as has already been attained at Calumet, it will be no unusual thing to hear that 250 pounds of sugar have been obtained." The average in the State heretofore has been about 125 or 130 pounds.

BULLETIN No. 24.

PROCEEDINGS OF SIXTH ANNUAL CONVENTION OF THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS (pp. 235).—This convention was held in Washington, at this Department, September 10–12, 1889, and its proceedings were edited by H. W. Wiley, secretary of the association. Besides a full account of the meeting, the bulletin contains the official methods of analysis of the association for 1887–88, including those for commercial fertilizers, cattle foods, dairy products, and fermented liquors, and a provisional method for sugar analysis.

BULLETIN No. 25.

A POPULAR TREATISE ON THE EXTENT AND CHARACTER OF FOOD ADULTERATIONS. A. J. WEDDERBURN (pp. 61).—This is a collation of "evidence in regard to the extent and character of food adulteration, derived largely from the work of the various State sanitary bodies, official reports, documents, and discussions upon which the laws of the different States were based, the laws of the various States themselves, and the expressions of numerous scientific men on this subject." The bulletin is divided into the following sections: (1) Introduction, on the character and extent of adulteration and the need for national legislation on the subject. (2) A brief notice of the work done by the Department of Agriculture. (3) Extracts from reports of various State authorities and sanitary bodies. (4) Evidence showing the necessity for inspection both before and after slaughter of animals intended for food. (5) Extracts from letters and reports indicating public opinion on this subject, etc. (6) Food products adulterated and adulterants commonly used. (7) A list of States and countries having anti-adulteration laws.

The author believes that the percentage of adulteration, sophistication, and misbranding of food products is not far from 15 per cent, which would imply a loss to the people of this country alone of $675,000,000 a year. This estimate, however, is much larger than that given by other authorities on this subject.

The general conclusions reached are: "(1) That adulterations exist to an extent that threatens every species of food supply. (2) That while these adulterations are mainly commercial frauds, practiced by unscrupulous manufacturers, manipulators, and dealers for the purpose of deceiving their customers and adding to their gains, yet there are also, to an alarming extent, poisonous adulterations that have, in many cases, not only impaired the health of the consumer but frequently caused death."

The argument for national legislation to prevent adulteration is thus summarized: "In view of the extensive and increasing adulteration, misbranding, and debasing of food, liquors, and drugs, and in view of the fact that such practices can not be entirely and effectually regulated by State laws, owing to the numerous complications arising from interstate commerce, it becomes necessary that State laws should be supplemented by national law on this subject. Such national legislation is demanded not only by the State authorities but by public opinion."

BULLETIN No. 13, PART V.

Baking powders, C. A. Crampton (pp. 561–627).—This is a continuation of the report on the investigation of foods and food adulteration by this Department, of which four parts have previously been issued.

The subject treated is baking powders, their character, composition, and analysis. The ordinary methods of aerating bread are first considered, including the use of yeast and the incorporation of carbonic-acid gas with the dough, and then the chemicals which may be used for the same purpose are mentioned.

The consumption of baking powders in the United States is given as nearly as it could be ascertained in the absence of any established statistics on this point. Baking powders are classified in three principal divisions, according to the nature of the acid constituent used in driving off the carbonic-acid gas. Each of these classes is taken up in turn, the chemical reactions which occur when the powder is dissolved are stated, and the nature of the residue is discussed.

Particular attention is paid to the class of baking powders known as alum powders, on account of the prominence which has been given to the question of the healthfulness and propriety of the use of alum in breadstuffs. Various opinions and authorities are quoted on both sides of the question and conclusions are drawn in so far as the evidence will permit. The different classes of baking powders are also compared with reference to their relative aerating strength and the amount of residue left by each.

The composition of baking powders as found in the market is next considered. Full abstracts are made of official reports upon this subject by Prof. H. A. Weber, in the "First Annual Report of the Ohio State Dairy and Food Commission for 1887," which gives the results of a partial analysis of a large number of samples; and by Professor Cornwall, in the "Report of the Dairy Commissioner of New Jersey for 1888." The analyses made in the course of the investigation by this Department are also given, and the methods of analysis used are discussed in detail, together with the comparative results of different methods. The methods of analysis used include the following determinations: Estimation of carbonic acid, both total and available; estimation of starch by direct determination; estimation of phosphoric acid, of tartaric acid, alkalies, aluminum, calcium, sulphuric acid, ammonia, and moisture. The results of the analyses are given in full, the percentage composition being calculated in one table and the probable percentage combination in another, with notes and comments upon peculiar combinations and constituents in certain cases. The results of the analyses were found to agree substantially with those obtained in the investigations of Professors Weber and Cornwall.

The difficulties in the way of the preparation of baking powders in the household are stated, and simple formulas are given whereby, with proper care, any housekeeper may make up baking powder which will be in all respects equal if not superior to any of the brands sold in the market and much less expensive.

The regulation of the sale of baking powders by law is advocated in so far as to require the formula and composition of each brand to be printed on the package, in order that the consumer may be fully informed of the character of the powder which he buys.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

JANUARY 15 TO MARCH 1, 1890.

Division of Statistics:

- Report No. 70 (new series), January and February, 1890.—Numbers and Values of Farm Animals.

Division of Entomology:

- Bulletin No. 21.—Report of a Trip to Australia to Investigate the Natural Enemies of the Fluted Scale.
- Periodical Bulletin, Vol. II, Nos. 7 and 8, January and February, 1890.—Insect Life.

Division of Chemistry:

- Bulletin No. 25.—A Popular Treatise on the Extent and Character of Food Adulterations.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS

JANUARY 15 TO MARCH 1, 1890.

ALABAMA.

Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama:

Bulletin No. 10 (new series), January, 1890.—Grape Culture.

CALIFORNIA.

Agricultural Experiment Station of the University of California:

Bulletin No. 85, February 15, 1890.—Observations on Olive Varieties.

CONNECTICUT.

The Connecticut Agricultural Experiment Station:

Bulletin No. 101, January, 1890.—Fertilizer Analyses.

FLORIDA.

Agricultural Experiment Station of Florida:

Bulletin No. 7, October, 1889.—Corn, Cucumbers, and Muck.

Bulletin No. 8 and Annual Report, January, 1890.—Cotton, Weeds of Florida, and Annual Report.

GEORGIA.

Georgia Agricultural Experiment Station:

Bulletin No. 5, October, 1889.—Reorganization of Station.

Bulletin No. 6, January, 1890.—Entomological Notes, and "Southern Drift" and its Agricultural Relations.

ILLINOIS.

Agricultural Experiment Station of the University of Illinois:

Second Annual Report, 1888–89.

KANSAS.

Kansas Agricultural Experiment Station:

Bulletin No. 7, July, 1889.—Experiments with Wheat.

Bulletin No. 8, October, 1889.—Preliminary Report of Smut in Oats.

Bulletin No. 9, December, 1889.—Experiment in Pig Feeding.

LOUISIANA.

State Experiment Station:

Bulletin No. 26.—Annual Report for 1889.

MASSACHUSETTS.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:
Fertilizer Analyses, August–September, 1889.
HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:
Bulletin No. 7, January, 1890.—Fruits, Vegetables, Combined Fungicides and Insecticides for Potatoes, Japanese Crops and the Gipsy Moth.
Meteorological Bulletins Nos. 1–13. January, 1889. to January, 1890.
Second Annual Report, January, 1890.

MICHIGAN.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:
Bulletin No. 55, December, 1889.—Fruit Testing.
Bulletin No. 56, February, 1890.—Rib-grass or Narrow-leaved Plantain in Fields of Clover.

NEVADA.

NEVADA AGRICULTURAL EXPERIMENT STATION:
Second Annual Report for year ending June 30, 1889.

NEW JERSEY.

NEW JERSEY STATE AND COLLEGE AGRICULTURAL EXPERIMENT STATIONS:
Bulletin No. 56, July 15, 1889.—Analyses and Valuations of Complete Fertilizers.
Bulletin No. 57, July 31, 1889.—Experiments with Different Breeds of Dairy Cows.
Bulletin No. 58, August 5. 1889.—Analyses of Incomplete Fertilizers.
Bulletin No. 59, September 23, 1889.—Analyses and Valuations of Complete Fertilizers.
Bulletin No. 60, October 30, 1889.—Ground Bones and Miscellaneous Samples.
Bulletin No. 61, October 31. 1889.—Experiments with Different Breeds of Dairy Cows.
Bulletin No. 62, November 6, 1889.—The Horn Fly.
Bulletin No. 63, December 30, 1889 —Experiments on Tomatoes.
Special Bulletin C, April 8, 1889.—Pollen *vs.* Rain.
Special Bulletin D, April 9, 1889.—Memoranda about Cranberry Insects.
Special Bulletin E, April 13, 1889.—Oyster Interests of New Jersey.
Special Bulletin F, July 26. 1889.—The Horn Fly.
Special Bulletin G, August 7. 1889.—The Potato Rot.
Special Bulletin H, August 28, 1889.—The Cranberry Scald.
Special Bulletin I, October 28. 1889.—Questions Relative to General Farm Practice.
Special Bulletin J, November 30, 1889.—The Sweet-Potato Rot.
Second Annual Report of the College Station for year ending June 30. 1889.

NEW YORK.

NEW YORK AGRICULTURAL EXPERIMENT STATION:
Eighth Annual Report for 1889.

NORTH CAROLINA.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 67, October 15, 1889.—Seed Tests.
Bulletin No. 68, November 1, 1889.—Farm and Dairy Buildings.

OHIO.

Ohio Agricultural Experiment Station:

Bulletin No. 14 (second series). Vol. II, No. 7, November, 1889.—Cabbage, Cauliflower, Remedies for certain Plant Diseases.

RHODE ISLAND.

Rhode Island State Agricultural Experiment Station:

Bulletin No. 4, December, 1889.—Bee Keeping.

SOUTH CAROLINA.

South Carolina Agricultural Experiment Station:

Bulletin No. 7 (new series 2), October, 1889.—Meteorological Data.

SOUTH DAKOTA.

South Dakota Agricultural Experiment Station:

Second Annual Report for year ending June 30, 1889.

TENNESSEE.

Tennessee Agricultural Experiment Station:

Second Annual Report for 1889.

VERMONT.

Vermont State Agricultural Experiment Station:

Bulletin No. 18, January, 1890.—Pig Feeding.

WISCONSIN.

Agricultural Experiment Station of the University of Wisconsin:

Sixth Annual Report, 1889.

DOMINION OF CANADA.

Department of Agriculture, Ottawa, Canada:

Central Experimental Farm, Bulletin No. 6, January, 1890.—Barley.

Bureau of Industries, Toronto, Ontario:

Annual Report, 1888.

Bulletin No. 30, November, 1889.—The Swine Industry in Ontario.

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TABLE OF CONTENTS.

Page.

- Editorial notes 245
  - Agricultural investigations in Canada 245
  - International Agricultural Congress at Vienna 246
  - Imperial College of Agriculture and Dendrology, Tokio, Japan 247
  - Suggestions as to investigations in dairying 247
  - Facts relating to new colleges and stations 248
- Abstracts of station bulletins, July–December, 1889, Part II 249

MISSOURI:

- *Missouri Agricultural Experiment Station* 249
  - Bulletin No. 7 249
    - Green *vs.* dry storage of fodder, J. W. Sanborn, B. S 249
  - Bulletin No. 8 250
    - Experiments in feeding silage against dry fodder, J. W. Sanborn, B. S 250
  - Bulletin No. 9, December, 1889 251
    - Study of the life history of corn at its different periods of growth, P. Schweitzer, Ph. D 251

NEBRASKA:

- *Agricultural Experiment Station of Nebraska* 252
  - Bulletin No. 11, December 18, 1889 252
    - The smut of wheat and oats, J. C. Arthur, D. Sc 252
    - The smut of Indian corn (*Ustilago maydis*), C. E. Bessey, Ph. D 252
    - A preliminary enumeration of the rusts and smuts of Nebraska, H. J. Webber, B. S 253
    - Notes on fungi of economic interest observed in Lancaster County, Nebraska, during the summer of 1889, R. Pound, B. A 253
    - Observations on the cotton-wood (*Populus monilifera*), A. F. Woods 253
  - Bulletin No. 12 254
    - Field experiments for 1889, J. G. Smith, B. S 254
      - Grasses 254
      - Clovers and other forage plants 254
      - Potatoes 254
      - Garden vegetables 254
      - Cereals 254
      - Clover seed impurities 254

NEVADA:

- *Nevada Agricultural Experiment Station* 255
  - Bulletin No. 6, September, 1889 255
    - Meteorological report for July, August, and September, 1889, W. S. Devol, B. Agr 255
  - Bulletin No. 7, December, 1889 255
    - Meteorological report for October, November, and December, 1889, W. S. Devol, B. Agr 255

Page.

NEW HAMPSHIRE:

New Hampshire Agricultural Experiment Station 255
  Bulletin No. 8, November, 1889 255
    Feeding experiments, G. H. Whitcher, B. S 255

NEW JERSEY:

New Jersey State and Agricultural College Experiment Stations 256
  Bulletins Nos. 56 and 59, July 15 and September 23, 1889 256
    Analyses of commercial fertilizers, E. B. Voorhees, M. A 256
  Bulletin No. 57, July 31, 1889 258
    Experiments with different breeds of dairy cows, G. H. Cook, LL. D 258
  Bulletin No. 58, August 5, 1889 258
    Analyses of incomplete fertilizers, G. H. Cook, LL. D 258
  Bulletin No. 60, October 30, 1889 259
    Analyses of ground bones and miscellaneous samples of fertilizers, E. B. Voorhees, M. A 259
  Bulletin No. 61, October 31, 1889 260
    Experiments with different breeds of dairy cows, M. E. Gates, Ph. D 260
  Bulletin No. 62, November 6, 1889 260
    The horn fly (*Hæmatobia serrata*), J. B. Smith 260
  Bulletin No. 63, December 30, 1889 261
    Tomatoes—effects of different methods of manuring, and chemical composition, E. B. Voorhees, M. A 261
  Bulletin No. 64, December 31, 1889 263
    Some fungous diseases of the cranberry, B. D. Halsted, D. Sc 263
      Cranberry gall fungus 263
      Cranberry scald 263
  Special Bulletin F, July 26, 1889 264
    The horn fly, J. B. Smith 264
  Special Bulletin G, August 7, 1889 264
    The potato rot, B. D. Halsted, D. Sc 264
  Special Bulletin H, August 28, 1889 264
    The cranberry scald, B. D. Halsted, D. Sc 264
  Special Bulletin I, October 28, 1889 264
    Questions relating to general farm practice, E. B. Voorhees, M. A 264
  Special Bulletin J, November 30, 1889 265
    The sweet-potato rot, B. D. Halsted, D. Sc 265

NEW YORK:

New York Agricultural Experiment Station 265
  Bulletin No. 16 (new series), July, 1889 265
    A study of the corn plant 265
    Lucern or alfalfa 266
  Bulletin No. 17 (new series), October, 1889 266
    Cattle foods and feeding rations, P. Collier, Ph. D 266
  Bulletin No. 18 (new series), November, 1889 269
    Testing of dairy breeds, P. Collier, Ph. D 269
Cornell University Agricultural Experiment Station 271
  Bulletin No. 7, July, 1889 271
    On the influences of certain conditions upon the sprouting of seeds, L. H. Bailey, M. S 271

NEW YORK—Continued. Page.

Cornell University Agricultural Experiment Station—Continued.

Bulletin No. 8, August, 1889 273
The effect of different rations on fattening lambs, I. P. Roberts, M. Agr., and H. H. Wing, B. Agr 273
Manurial value of the rations 275
Bulletin No. 9, September, 1889 276
A study of wind-breaks in their relations to fruit growing, L. H. Bailey, M. S 276
Bulletin No. 10, October, 1889 276
Notes on tomatoes, L. H. Bailey, M. S 276
Bulletin No. 11, November, 1889 277
On a saw-fly borer in wheat, J. H. Comstock, B. S 277
Bulletin No. 12, December, 1889 278
A new apparatus for drying substances in hydrogen and for the extraction of the fat, G. C. Caldwell, Ph. D 278
Bulletin No. 13, December, 1889 279
On the deterioration of farm-yard manure by leaching and fermentation, I. P. Roberts, M. Agr., and H. H. Wing, B. Agr 279
On the effect of a grain ration for cows at pasture, I. P. Roberts, M. Agr., and H. H. Wing, B Agr 280
Bulletin No. 14, December, 1889 281
On the strawberry leaf blight (*Spharella fragariæ*, Sacc.), W. R. Dudley, M. S 281
Ascochyta fragariæ, Sacc., W. R. Dudley, M. S 282
Bulletin No. 15, December, 1889 282
Miscellaneous analyses, 1889, W. P. Cutter, B. S 282
Studies in botany, A. N. Prentiss, M. S 282
Studies in cryptogamic botany, W. R. Dudley, M. S 283
The apple-tree tent caterpillar (*Clisiocampa americana*), J. H. Comstock, B. S 283
Field trials with fertilizers, I. P. Roberts, M. Agr 283
A point in the cultivation of root-crops, I. P. Roberts, M. Agr 283
Studies in horticulture, L. H. Bailey, M. S 283

NORTH CAROLINA:

North Carolina Agricultural Experiment Station 283
Bulletin No. 64, July, 1889 283
Practical stock feeding on scientific principles, F. B. Dancy, B. A 283
Bulletin No. 65, August–September, 1889 284
Cooperative field tests during 1888, H. B. Battle, Ph. D 284
Bulletin No. 66, September 15, 1889 285
Stock feeding as practiced in North Carolina, F. B. Dancy, B. A 285
Indian corn, G. McCarthy, B. S 286
Bulletin No. 67, October 15, 1889 286
Seed tests, G. McCarthy, B. S 286
Bulletin No. 68, November 1, 1889 286
Farm and dairy buildings, J. R. Chamberlain, B. S 286

OHIO:

Ohio Agricultural Experiment Station 287
Bulletin Vol. II, No. 4 (second series), July, 1889 287
Experiments with small fruits in 1889, W. J. Green 287

OHIO—Continued.

Page.

- *Ohio Agricultural Experiment Station*—Continued.
  - Bulletin Vol. II, No. 4—Continued.
    - Effect of early and late picking upon the keeping quality of apples, W. J. Green 287
  - Bulletin Vol. II, No. 5 (second series), August, 1889 287
    - Experiments in wheat seeding, J. F. Hickman, M. A. S 287
      - Commercial fertilizers on wheat 288
    - Comparative test of varieties of wheat, J. F. Hickman, M. A. S 289
  - Bulletin Vol. II, No. 6 (second series), September, 1889 290
    - Remedies for the plum curculio (*Conotrachelus nenuphar*), C. M. Weed, M. S 290
    - Remedies for the striped cucumber beetle (*Diabrotica vittata*), C. M. Weed, M. S 290
    - Third contribution to a knowledge of the life history of certain little-known plant lice, C. M. Weed, M. S 291
    - Notes on some little-known injurious insects, C. M. Weed, M. S 291
    - An experiment in preventing the injuries of the potato rot (*Phytophthora infestans*), C. M. Weed, M. S 291
  - Bulletin Vol. I, No. 1 (technical series), October, 1889 292
    - On the preparatory stages of the 20-spotted lady-bird (*Psyllobora 20-maculata*, Say), C. M. Weed, M. S 292
    - Studies in pond life, C. M. Weed, M. S 292
    - A partial bibliography of insects affecting clover, C. M. Weed, M. S 292
  - Bulletin Vol. II, No. 7 (second series), November, 1889 293
    - Early cabbage—comparison of varieties, W. J. Green 293
    - Cauliflower—comparison of varieties, W. J. Green 293
    - Puget Sound cabbage and cauliflower seed, W. J. Green 294
    - Notes on experiments with remedies for certain plant diseases, C. M. Weed, M. S 294
  - Bulletin Vol. II, No. 8 (second series), December, 1889 294
    - Eighth annual report for 1889 294

OREGON:

- *Oregon Experiment Station* 294
  - Bulletin No. 3, October, 1889 294
    - Practical work with insecticides, E. R. Lake, M. S 294
    - Corn worm (*Heliothis armigera*), F. L. Washburn, B. A 295
    - Insecticides and spraying machines, F. L. Washburn, B. A 295
    - Plants poisonous to stock, P. H. Irish, Ph. D 295

PENNSYLVANIA:

- *The Pennsylvania State College Agricultural Experiment Station* 295
  - Bulletin No. 8, July, 1889 295
    - Systematic testing of new varieties—germination tests, G. C. Butz, M. S 295
  - Bulletin No. 9, October, 1889 296
    - Digestibility of corn fodder and silage, H. P. Armsby, Ph. D., and Wm. H. Caldwell, B. S 296

RHODE ISLAND:

- *Rhode Island State Agricultural Experiment Station* 296
  - Bulletin No. 3, September, 1889 296
    - Stock feeding, H. J. Wheeler, Ph. D 296

RHODE ISLAND—Continued. Page.
Rhode Island State Agricultural Experiment Station—Continued.
Bulletin No. 4, December, 1889 ... 296
Bee keeping, S. Cushman ... 296
Report of the apiarist, S. Cushman ... 297
Bulletin No. 5, December 31, 1889 ... 297
Potatoes—methods of planting and test of varieties, L. F. Kinney, B. S ... 297
Meteorological summary ... 298
Abstracts of publications of United States Department of Agriculture, Part III ... 299
Division of Statistics ... 299
Miscellaneous Report No. 1 (new series) ... 299
Report on flax, hemp, ramie, and jute, C. R. Dodge ... 299
Division of Chemistry ... 300
Bulletin No. 26 ... 300
Record of experiments in the production of sugar from sorghum in 1889, H. W. Wiley ... 300
Division of Entomology ... 301
Bulletin No. 21 ... 301
Natural enemies of the fluted scale in Australia, A. Koebele ... 301
Silk Section ... 302
Bulletin No. 1 ... 302
How to raise silkworms, Philip Walker ... 302
List of publications of the United States Department of Agriculture, March 1 to May 1, 1890 ... 303
List of station publications received by the Office of Experiment Stations, March 1 to May 1, 1890 ... 304

EXPERIMENT STATION RECORD.

Vol. 1. **MAY, 1890.** **No. 5.**

EDITORIAL NOTES.

The following facts concerning agricultural investigations in Canada are taken in part from the fifteenth annual report of the Ontario Agricultural College and Experimental Farm for 1889:

"In the year 1886 an act of Parliament was passed by the Dominion Government, making provision for the establishment of five experimental farms throughout Canada, the principal one to be at Ottawa, and to serve for both Ontario and Quebec; the other four being located as follows: One in the Maritime Provinces, one in Manitoba, one in the Northwest Territories, and one in British Columbia. The farms have been purchased and a superintendent engaged for each. Experimental work was commenced on the Central Farm in 1886, and upon the others about two years later. No pains are being spared in making these experimental centers an honor to Canada."

The Central Farm, situated in the suburbs of Ottawa, comprises 466 acres. The land is from 40 to 80 feet above the adjacent rivers, and is so located that part of it drains into the Rideau River and part into the Ottawa River. The soil varies from heavy clay to light, sandy loam, but a dark, sandy loam of good quality and a friable clay loam predominate.

The experimental farm for the Maritime Provinces is at Nappan, Nova Scotia. It comprises about 300 acres, including woodland, marsh or dyke land, and lower and higher upland. The soil is chiefly clay loam with a subsoil varying from clay to gravelly clay. In Manitoba the farm is near Brandon, 132 miles west of Winnipeg, and contains 640 acres of meadow land sloping up from the Assiniboine River and including a portion of the bluffs which form the boundary of the river valley. The soil varies from the rich, dark, clay loam of the bottom-land to a sandy loam along the bluffs. "It has a large area of soil which fairly represents the great grain-growing districts of Manitoba." The farm for the Northwest Territories is near Indian Head, about 100 miles north of the United States and the same distance west of the Manitoba boundary. It contains 640 acres, including a variety of clay and sandy soils, and when the experimenting began was all open prairie without trees or shrubs. There is a good supply of water on the farm. In British Columbia the farm is near the station called Agassiz on the Canadian Pacific Railway, 170 miles east of Vancouver. It comprises 300 acres, mainly neglected prairie land which had been cleared many years ago, with about 50 acres of woodland, and 35 of cultivated land, including an orchard. There is here a variety of clay and sandy soils, and all the land is sufficiently high to prevent its being overflowed at any time by the Fraser River.

These farms are under the general management of Prof. William Saunders as director. The working staff at the Central Experimental Farm includes F. T. Shutt, M. A., chemist; James Fletcher, entomologist and botanist; W. W. Hilborn, horticulturist, and A. G. Gilbert, poultry manager. W. M. Blair is superintendent of the farm at Nappan; S. A. Bedford, at Brandon; Angus Mackay, at Indian Head, and T. A. Sharpe at Agassiz. The annual report of the investigations conducted at these farms is published as an appendix to the report of the minister of agriculture. A number of bulletins have also been issued by the Central Farm.

The Ontario Agricultural College at Guelph was established in 1874. Two years later work was begun in the experimental department of the College, when 40 plats were used for experimental purposes. In 1885, 170 plats, or 23 acres, were so used, and in 1889, 464 plats, or about 58 acres. Feeding experiments have been conducted since 1886. "Chemical analyses were commenced during the year 1883, and since that date a new laboratory has been erected, and the conveniences greatly increased for this very important branch of the Station's work. Waters, milks, soils, fertilizers, roots, grains, and plants have been analyzed so far as time could be secured for this. When the professor of dairying was appointed, the dairy experiments were put under his direct supervision, the creamery was continued, a silo erected, and numerous experiments with corn and dairy stock conducted."

An association called the Ontario Agricultural and Experimental Union, composed of over one hundred alumni, students, and professors of the College, is conducting cooperative experiments in the Province of Ontario with grains and fertilizers, and in horticulture, apiculture, dairying, feeding of animals, etc. This work has grown up rapidly within a few years, and will doubtless exert a very beneficial influence on the agriculture of the Province.

An international congress will be held at Vienna in connection with the agricultural exhibition to take place there from May to November, 1890, under the auspices of the Imperial Royal Agricultural Society of Vienna. The congress will meet early in September and will be organized in seven sections, as follows:

(1) Agriculture in general, including stock raising and veterinary theory and practice.

(2) Agricultural specialties, such as the raising of fruit, tobacco, hops, flax, silk-worms, bees, or fishes, and the making of wine.

(3) Agricultural engineering, including irrigation, drainage, swamp culture, utilization of offal, etc.

(4) Agricultural industries, such as the making of sugar, starch, and yeast, brewing and distilling, milling, dairying, etc.

(5) Agricultural science and education, including schools of different grades and experiment stations.

(6) Forestry, including general forestry, the lumber trade, forest engineering, instruction in forestry, etc.

(7) Rural economy, including legislation, statistics of agriculture, cooperative associations, insurance and loans, protection for birds, etc.

This Office has received seven bulletins of the Imperial College of Agriculture and Dendrology, Tokio, Japan, published in English, from December, 1887, to March, 1890, inclusive. The first is by Prof. C. C. Georgeson, M. S.; the five succeeding by Dr. O. Kellner, and the last by Y. Kozai. The titles of the bulletins are as follows: No. 1, Fertilizer Experiments with Rice; No. 2, The Composition and Digestibility of Japanese Feeding Stuffs; No. 3, The Composition, Treatment, and Application of Night-soil as a Manure, and the Valuation of Japanese Fertilizers; No. 4, The Composition of Several Japanese Fertilizers; No. 5, The Distribution of Vegetable and Animal Nutrients in the Products Obtained from Rice by Whitening, and the Manufacture, Composition, and Properties of "Koji" (steamed rice or barley upon which is developed the mycelium of a special fungus); No. 6, The Manufacture and Composition of "Miso" (a food prepared from a mixture of soy beans, rice or barley, common salt, and water, by slow fermentation, and much used, especially by the lower classes, in connection with vegetables), and Experiments with Several Nitrogenous Fertilizers on Crops (barley and rice, in zinc cylinders buried in a field); No. 7, The Manufacture of Various Kinds of Tea and the Nitrogenous Non-albuminous Constituents of Bamboo Shoots.

An agricultural and industrial exposition is now in progress at Tokio, and will be continued until July 31.

On page 267, in the abstract of Bulletin No. 17 of the New York Station on cattle foods and feeding rations, estimates are given of the quantities of different feeding stuffs and the digestible nutrients in rations fed to cows by leading New York dairymen. To these are added estimates of the fuel values of the rations in heat units. The different rations varied in fuel value from about 18,000 to 43,000 calories per cow per day. The quantities of protein were even more variable, the range being from 0.85 to 2.57 pounds. While the figures given for the daily rations are not assumed to be entirely accurate, they show that the variations in the feeding practice of these dairymen are great, and emphasize in a very striking way the need of better understanding of the principles and closer economy in the practice of feeding. Such facts as these bring out very clearly the need of experimental inquiry in two directions. On the one hand, it is important, indeed indispensable, that we have more thorough knowledge of the chemical constitution of the materials used for feeding stuffs. The studies need to be prosecuted in such ways as to determine, for each species of plant and for the different parts of the same plant, the kinds of proximate ingredients, the amount of each ingredient, and its molecular constitution, its digestibility, and its fuel value as measured by its potential energy. These data are wanted for an accurate understanding of the nutritive values of the materials fed. Along with this, of course, is the parallel demand for better understanding of the ways in which they are used in nutrition. On the other hand, there is call for closer study of the methods of feeding in use by practical farmers; such information as can best be obtained by accurate observations of the kinds and amounts of feeding stuffs used and the yields of milk and butter in different dairies. In other words, the union of abstract science with practical observation and experiment, in such ways as advanced knowledge and experience indicate, is necessary to get the information which the dairy interests of the country demand, and the same applies to feeding for other than dairy purposes.

According to the latest advices received by this Office, A. E. Blount, M. A., of the Colorado Agricultural College and Experiment Station, has been elected horticulturist and agriculturist of the New Mexico Agricultural College and Station, and E. O. Wooton, B. S., is to be botanist and chemist of the same institution. W. P. Cutter, B. S., of the New York (Cornell) Station, and E. S. Richman, B. S., of the Arkansas Station, have gone to the Utah Station. By an act of the legislature of North Dakota, approved March 8, 1890, an agricultural college and experiment station have been established at Fargo, North Dakota. The board of directors perfected their organization May 1 by the election of O. W. Francis, president; J. B. Power, secretary, and S. S. Lyon, treasurer, and at an adjourned meeting, held May 15, appointed as a station staff S. T. Satterthwaite, director; James Holes, superintendent of farm experiments, and Jacob Lowell, general superintendent. The necessary grounds and buildings have been secured, and preparations made to commence the work of the Station without delay.

ABSTRACTS OF BULLETINS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES FROM JULY TO DECEMBER, 1889.

PART II.

MISSOURI.

Missouri Agricultural Experiment Station.

Department of Missouri Agricultural College.

Location, Columbia. Director, Edward D. Porter, Ph. D.*

BULLETIN No. 7.

GREEN VERSUS DRY STORAGE OF FODDER, J. W. SANBORN, B. S. (pp. 3–20).—This is a report of experiments regarding the relative cost of silage and dry storage of corn and the nutritive values of the silage and dried corn under such conditions as are found in Missouri.

(1) *Relative cost of silos and barns.*—According to the figures given in the bulletin the stone silo on the College farm, which is 16 by 22 feet and 16 feet deep, inside measure, and has a capacity of about 90 tons, cost $453. In this silo the cost of storage room for the silage from an acre of land, estimated to average 20 tons, would be $100. The cost of erecting a wooden silo of the same size as the stone one was estimated by a local contractor at $292. In the same way it was estimated that a barn to hold 23 tons of timothy hay, the dry matter in which would equal that in the silage held by a silo of the size above mentioned, would cost $224. In these estimates lumber is reckoned at $17.50 per thousand feet.

(2) *Experiment in storing green and dry fodder.*—The stover of a number of rows of sweet and field corn was put into the stone silo, and that of the alternate rows was dried and stored in a compact body in a barn. Both kinds of fodder kept quite well, but the silage was computed to have lost 15.41 per cent of its dry matter by "shrinkage," and enough more was spoiled to bring the total loss up to 34.3 per cent. The dry fodder lost, by the computation, only 5.56 per cent of its dry matter by "shrinkage." This large difference in the amount of loss of dry matter by the two methods of storage, as compared with that found by other experimenters, is thought by the author to be largely due to the compactness with which the dry fodder was stored in this experiment. The analyses were, however, unsatisfactory, and the computations of loss may not be entirely correct.

---

* When Bulletins Nos. 7 and 8 of this Station were prepared, J. W. Sanborn was director.

(3) *Relative cost of harvesting and storing green and dry fodder.*—Calculations are given to show that the cost of harvesting and storing silage under such conditions as obtain at the Station is not less than 75 cents per ton, or $15 for an acre producing 20 tons, while the same amount of dry fodder can be harvested, stored, and cut for feeding for $13.70; and taking into account the relative loss of dry matter and the relative cost of the silo and the barn, including interest and wear of building, the comparative expensiveness of silage is made to appear very great.

Conclusions.—The following are among the conclusions drawn from these investigations:

(1) The storage room for a ton of silage in a wooden silo at the Station would cost $3.40; for 20 tons, *i. e.*, the product of an acre, in a wooden silo, $68; in a stone silo, $100; for an amount of dry matter in hay equal to that in 20 tons of silage, $49.59.

(2) In the experiments reported the total loss of food material (dry matter) from "shrinkage" and "spoiling" was 34.3 per cent for silage, and for dry field corn from "shrinkage" alone, 5.56 per cent.

(3) The dry matter preserved from 20 tons of silage could be raised in 3.16 tons of hay and at less cost.

(4) The silo insures against the leaching effects of rains, but this is not sufficient to compensate for the destructive effects of the silo itself.

(5) Up to the point of feeding silage, dry storage is the better method for Missouri farmers, according to the teachings of the data recorded in this bulletin.

Composition of feeding stuffs.—Analyses of amber sorghum, sorghum, sweet-corn, and field corn, and of silage from them are reported in the appendix.

BULLETIN No. 8.

EXPERIMENTS IN FEEDING SILAGE AGAINST DRY FODDER, J. W. SANBORN, B. S. (pp. 3–24).—In the introduction to this article the method of comparing silage and dry fodder as to feeding value by experiments during short, alternate periods is criticised, and the errors from neglecting such important factors as palatableness, weight of food in the stomach, and influence of the water in the silage, are insisted upon. "Years of experience with me have shown unmistakably that it is highly unsafe to depend upon an equal number of pounds of digestible food as now ascertained to give an equal growth when derived from two sources."

In the feeding experiments reported in this bulletin timothy hay, meal, bran, etc., are used in all. Silage and dry fodder from field and sweet-corn are the variable constituents. In one experiment two lots of three steers each were fed alike during a preliminary period of thirty days, and thereafter with silage or dry corn (in addition to the other food, which was the same for both) as follows: (1) Lot I on silage from field corn, and lot II on dry fodder from field corn, for twenty-eight days. (2) Lot I on silage from sweet corn, and lot II on dry fodder from sweet-corn, for twenty-one days. (3) Lot I on silage from field corn, and lot II on dry fodder from field corn, for forty-six days. In another experiment two lots of three cows each received dry corn fodder and silage as follows: Lot I silage, and lot II dry fodder, for thirty-five days; and lot I dry fodder, and lot II silage, for sixty-five days. The milk yield for both periods and the butter yield from two settings of milk for each period are given, as well as analyses of the feeding stuffs and of the milk. The analyses of the feeding stuffs and products were not as detailed and complete as was desirable, so the author does not regard the conclusions as final.

Among the general statements based on these experiments are the following: (1) A given amount of food, dry stored, lasted longer than the same amount of food put into the silo. (2) The ratio of growth of steers fed on dry food equaled or exceeded that of the silage-fed steers when compared with the growth of each lot when both were fed alike, yet the total growth of silage-fed steers was the greater. (3) The steers fed on silage seemed to have made relatively less growth of solid matter and more of water. (4) Sweet-corn fodder was apparently more effective for the cows and less so for the steers than field-corn fodder. (5) With the cows the dry fodder, especially from sweet corn, was apparently better than silage. The specimens of milk from the dry fodder contained a larger per cent of solids and yielded more and better butter, and the cows maintained their live weight best on dry fodder. (6) The trial, as a whole, implied that the air-drying method with dry storage in a good barn, in a compact form, was decidedly the more economical method of the two. (7) "In a very bad year the disadvantages of the air-drying system might be equal to the disadvantages of the silo, but they would have to be severe to warrant stock raisers in Missouri in investing in the silo extensively. The facts secured will not warrant me in advising our farmers to build silos until a radical change in the effectiveness and economy of the silo is made, or a radical change occurs in surrounding conditions."

BULLETIN No. 9, DECEMBER, 1889.

STUDY OF THE LIFE HISTORY OF CORN AT ITS DIFFERENT PERIODS OF GROWTH. P. SCHWEITZER, PH. D. (pp. 3-78).—This account of an extended and painstaking research includes a record of chemical analyses of the corn plant from samples taken at fourteen successive stages of growth, from June 11, forty days after planting, to September 24, "when the last plants were obtained fully ripe, though not quite dry." Tabulated results of the weighings and analyses of root, stem, leaf, tassel, husk, cob, grain, plant, and ear, separately and complete plant, are given, with explanations and conclusions. The weight in grammes of the whole corn plant and of its different parts at successive periods of growth, and the weight in pounds of the ash and other constituents of the corn plant, taken from an acre of land, are also given in tables. Details of the methods of experimenting employed and forty-four pages of analytical data are given in an appendix. Among the conclusions drawn are the following:

1. *The stem.*—The largest amount of dry matter in the stem and of stem in the whole plant was found on August 6 (when the grain was hardly in the milk state), indicating that the productive growth of the stem reaches its height about that date.

2. *The leaves.*—Measured in the same way as for the stem, the productive growth of the leaves reached its height about the same time, or a little earlier.

3. *The cob.*—The indications were that functional activity continues in the cob longer than in any other part of the plant.

4. *The grain.*—The object here was to ascertain (1) at what period of growth the ear may be severed from the stalk without impairing the vitality of the seed; (2) how and when the grain possesses its greatest relative and absolute value. The analyses showed an increase in the weight of the grain amounting to 24 per cent of the total weight between September 10, when the leaves were drying and dropping off, and September 24, when they were all dry and many gone. This increase was so large as "to indicate clearly that a crop of corn should remain in the field as long as possible, the weather permitting, to reach its greatest perfection."

5. *The whole plant.*—"The plant takes up nearly all the ash ingredients it needs during the first stages of growth, and subsequent additions are mechanically absorbed with the water imbibed by the roots," and, therefore, to develop well and profitably the plant must have easy access to an abundance of mineral matter during its early growth. Nitrogen was found in relatively large amounts in the young plant and decreased in relative amount as the ears developed. The young plant takes up nitrogen with extraordinary activity.

NEBRASKA.

Agricultural Experiment Station of Nebraska.

Department of the Industrial College of the University of Nebraska.
Location, Lincoln. Director, Lewis E. Hicks, Ph. D.

BULLETIN No. 11, DECEMBER 18, 1889.

THE SMUT OF WHEAT AND OATS, J. C. ARTHUR, D. Sc. (pp. 1–23), (illustrated).—An introduction to this article by C. E. Bessey, Ph. D., gives a brief explanation of the nature and injurious action of fungi and of the smuts in particular. Inquiries and investigations have shown that both the stinking and the black smut are common in Nebraska. Dr. Arthur's article is reprinted from Bulletin No. 28 of the Indiana Station, an abstract of which may be found in Experiment Station Record, Vol. I, No. 4, pp. 207–209.

THE SMUT OF INDIAN CORN (USTILAGO MAYDIS). C. E. BESSEY, PH. D. (pp. 25–35). (illustrated).—Notes on the general appearance of this disease: prevalence in this country and Europe: amount of injury to crop and to cattle: structure, growth, and name of the fungus: and measures for reducing the amount of smut. The following "popular summary" is taken from the bulletin:

> Corn smut is widely distributed throughout this country and the Old World. The injury resulting from its attacks varies from a fraction of 1 per cent to more than half of the crop.
>
> Experimenters differ in their opinions as to its harmfulness when eaten by cattle, but it is certain that it is not an active poison.
>
> The black powder of the smut consists of the spores, which are simple, seed-like, reproductive bodies. These reproduce smut much as seed reproduce ordinary plants.
>
> Smut spores may grow in manure and liquids in the barn-yard for an indefinite period.
>
> The smut enters the corn when it is very young, penetrating the soft tissues of the lowest joint and the root of the small plant.
>
> Smut does not pass from plant to plant in the corn field.
>
> Outward applications to the affected corn plant will do no good, for the fungus is inside, and no application will reach it.
>
> Care should be taken to keep the ground from becoming filled with spores.
>
> By a rotation of crops the increase of smut may be prevented.
>
> Domestic animals should not be allowed to eat the smut in the field, for they will distribute the spores in their droppings.
>
> Care should be taken not to contaminate yard manure with the spores.
>
> Infected stalks should be removed from the field before the smut balls open, and then be carefully destroyed.
>
> Plant none but seed which is perfectly free from smut spores.
>
> The spores adhering to seed corn may be killed by immersion in a strong solution of blue vitriol. In a general way the proportion may be given as follows, viz: *Use as many pounds of blue vitriol as gallons of water.* The immersion should not last longer than fifteen or twenty minutes. If the wet corn is placed upon sloping boards, the liquid may be drained off and used over again a number of times.

A PRELIMINARY ENUMERATION OF THE RUSTS AND SMUTS OF NEBRASKA, H. J. WEBBER, B. S. (pp. 37–82).—This is prefaced with an explanatory introduction by Dr. Bessey. The article contains a list of 119 species of rust and 21 of smut, with brief notes, and an index to the host plants.

NOTES ON FUNGI OF ECONOMIC INTEREST OBSERVED IN LANCASTER COUNTY, NEBRASKA, DURING THE SUMMER OF 1889, R. POUND, B. A. (pp. 83–91).—A list of 75 species, with brief notes.

OBSERVATIONS ON THE COTTON-WOOD (POPULUS MONILIFERA), A. F. WOODS (pp. 93–97).—Observations of the dates of the appearance and fall of the leaves, the angles of branches, and the number of lateral and terminal buds on trees of both sexes, led to the conclusion that the sex of cotton-wood trees can not be determined by any secondary characters.

BULLETIN No. 12.

FIELD EXPERIMENTS FOR 1889, J. G. SMITH, B. S. (pp. 1–63).—The subjects considered are, grasses and clover—adaptability; corn—quality, yield, and method of cultivation; potatoes—varieties, yield, and quality; fodder plants—maize, dhoura, Kaffir corn, and others; and variety tests of a number of common garden vegetables.

Grasses (pp. 1–11).—Notes on 27 varieties are given. The results of two years' experiments indicate the following grasses as the best of those tested:

> For early pasture, Kentucky blue-grass and orchard grass sown separately or mixed with other grasses and clovers, such as redtop, sheep fescue, meadow fescue, red clover, etc.
>
> For later pasture, meadow fescue, English perennial rye, sheep fescue, rough-stalked meadow grass, redtop, timothy, and the native grasses.
>
> For early hay, orchard grass, wild wheat grass, and redtop.
>
> For later hay, meadow fescue, English perennial rye, rescue grass, timothy, Johnson grass, and the Muhlenberg and other native grasses.
>
> As further experiments are made there will probably be changes in the list, and the names of the other grasses not yet tried added to those given above.
>
> As has been noted by Professor Bessey and others, the so-called tame grasses do not grow as well in virgin soil as on land which has been cultivated for a number of years. Undoubtedly many of the attempts to grow them have failed from this cause alone. The effects of a new soil and a changed climate on those crops which are regarded as "sure" in the older settled States may not always be favorable; but as cultivation increases better results will surely follow.

Clovers and other forage plants (pp. 11–17).—"Fifteen of the true clovers and their relatives that seemed more or less promising last year were tried again this. The best of these were red clover, alfalfa, and spring tares or vetches (*Vicia sativa*, L.)." Red clover has now been grown in almost every county of Nebraska, and its position as a reliable forage plant for that State seems no longer doubtful. Alfalfa has been tried in different parts of the State with varying results. Cow-peas have grown well at the Station during two years. Of the other forage plants experimented with, pearl millet for green fodder, Kaffir corn and dhoura for early seed and fodder, and yellow millo maize for large amounts of seed and fodder, are recommended.

Potatoes (pp. 18–25).—Tabular record of 169 varieties tested, with additional notes on a number of varieties.

Garden vegetables (pp. 26–37).—Notes on 4 varieties of sweet potatoes, 32 of beans, 31 of peas, 5 of onions, 8 of radishes, 3 of parsnips, 2 of salsify, 9 of beets, 8 of carrots, 12 of turnips, 4 of okra, 11 of cucumbers, 12 of musk-melons, 7 of water-melons, and 2 of pumpkins.

Cereals (pp. 38–61).—Notes on 13 varieties of oats, 4 of wheat, 17 of sweet corn, 14 of pop corn, 7 of flint corn, and 21 of dent corn.

Clover seed impurities (pp. 39–41).—An examination of clover seed bought from twelve different firms was made. The number of weed seeds in each 1,000 seeds examined varied from 5 to 340. If 15 pounds per acre of such seeds were sown, the number of weed seeds planted on an acre would be from 19,000 to 1,290,000.

NEVADA.

Nevada Agricultural Experiment Station.

Department of Nevada State University.

Location, Reno. Director, S. A. Jones, Ph. D.

BULLETIN No. 6, SEPTEMBER, 1889.

METEOROLOGICAL REPORT FOR JULY, AUGUST, AND SEPTEMBER, 1889, W. S. DEVOL, B. AGR. (pp. 1–18).—Notes and tabular record of readings of barometer and thermometer, and observations of dew-point, relative humidity, precipitation, velocity and direction of wind, cloudiness, and frosts. The sunshine recorder constructed at the Station in August is described.

BULLETIN No. 7, DECEMBER, 1889.

METEOROLOGICAL REPORT FOR OCTOBER, NOVEMBER, AND DECEMBER, 1889, W. S. DEVOL, B. AGR. (pp. 1–16).—Data similar to those in Bulletin No. 6 are here recorded for the last quarter of 1889.

NEW HAMPSHIRE.

New Hampshire Agricultural Experiment Station.

Department of New Hampshire College of Agriculture and the Mechanic Arts.

Location, Hanover. Director, G. H. Whitcher, B. S.

BULLETIN No. 8, NOVEMBER, 1889.

FEEDING EXPERIMENTS, G. H. WHITCHER, B. S. (pp. 3–17).

Principles of feeding (pp. 3–9).—Under this heading tables of feeding standards are given and their use explained.

Analyses of materials used in feeding experiments, winter of 1888–89 (pp. 9–11).—Here are given in tabular form results of analyses of early and late cut timothy hay, corn meal, middlings, shorts, cotton-seed meal, and gluten.

Feeding experiments with milch cows (pp. 11–17).—A tabular record of an experiment with seven cows during four periods of two weeks each, from March 11 to May 6, inclusive, in which corn meal, cotton-seed meal, and shorts are compared as variable ingredients of rations, which include in each case one of these materials, together with silage, rye hay, shorts, and gluten. There are also notes on experiments with single cows in which middlings are compared with shorts, middlings with gluten, and gluten with shorts.

Among the conclusions are: (1) Narrowing the nutritive ratio from the German standard of 5.4 to 4.5 did not materially increase the amount of milk. (2) Under the conditions of the experiment, a pound of digestible matter appeared to be slightly more efficient in the narrow than in the wide ration. (3) "We must not lose sight of the fact that the manure from the cotton-seed ration must have been more valuable, for the reason that corn meal contains only one-half as much phosphoric acid, one-third as much potash, and one-third as much nitrogen as does cotton-seed meal. This becomes an important matter when we consider the field work as well as our feeding."

NEW JERSEY.

New Jersey State and Agricultural College Experiment Stations.

Location, New Brunswick. Director, Merrill E. Gates, LL. D.

BULLETINS Nos. 56 AND 59, JULY 15 AND SEPTEMBER 23, 1889.

ANALYSES OF COMMERCIAL FERTILIZERS, E. B. VOORHEES, M. A. (pp. 2–15, 2–21).—These bulletins contain the chemical analysis and calculated commercial valuation per ton of samples representing 191 brands of complete fertilizers; Bulletin No. 56, including 73 and Bulletin No. 59, 118 brands.

Fertilizer inspection.—Samples of the brands sold in each county are obtained by an inspector located in that county. Five hundred and fifty samples were received in 1889, representing over 60 manufacturers, and including 191 different brands of complete fertilizers and a large number of samples of ground bone, dissolved bone, and miscellaneous fertilizing materials. The total number of brands sent in by the inspectors for 1888 and 1889 is as follows:

	1888.	1889.	Increase.
Complete fertilizers	170	191	21
Ground bone	19	25	6
Dissolved bone and miscellaneous samples	14	27	13
Total number	203	243	40

The increase of forty samples in total number, and the proportionately larger number in 1889 of ground bone, dissolved bone, superphosphates, potash, and other "incomplete" fertilizers, indicate that for these brands inspection has been much closer, or that their value is recognized and their use becoming more general.

Chemical analysis of fertilizers.—"This includes tests for the three forms of nitrogen, viz, as nitrates, as ammonia salts, and as organic matter, and a quantitative determination of each when found. In all cases the total, soluble, reverted, and insoluble phosphoric acid are determined. Potash and chlorine determinations are made in each sample, and the potash found in excess of that needed to form muriate of potash with the chlorine present is credited to the manufacturer as sulphate of potash. This complete examination of each sample is of value in furnishing information regarding the kind and quality of the materials used in mixed fertilizers."

Fertilizer guarantees.—"The guaranteed analysis of each brand was in most cases secured from the pamphlets of the manufacturer. Wherever these could not be obtained those reported by the inspectors are published." One hundred and twenty-three samples, or 64 per cent of the total number, equal or exceed the minimum guarantee claimed by the manufacturer. Only four fail to reach the guarantee in all respects, and two were unaccompanied by guarantees. Of the samples falling below the guarantees in one or more elements, twenty-three contained a large excess of the other elements over guarantee, twenty have an excess of one element, and the same number only equal the claim made in other respects. Two brands of fertilizers are mentioned by name as indicating that comparatively worthless materials find some buyers among New Jersey farmers despite the fact that they have been warned in regard to these brands.

Value of fertilizer guarantees.—"Guarantees are valuable as a guide in the purchase of fertilizers (1) when they state truly the relative proportions of the different ingredients in a mixed fertilizer, and (2) when they indicate that a sufficient amount of actual plant food is present to warrant the selling price." The analyses made in 1889 show that the guarantees in many cases do not indicate truly the proportion in which the nitrogen, phosphoric acid, and potash exist in the brands sold, and that the average selling price of the same brands is, in round numbers, $36 per ton, thus making an average difference of $10, with a range in individual cases of from $1 to $20 per ton. The conditions which make guarantees of most value are therefore not observed by all manufacturers selling in New Jersey. Improvements in the fertilizer trade in these particulars must come largely through the influence of the farmers themselves. They must know the analyses of the different brands and buy only those articles which fulfill the conditions mentioned.

Prices of fertilizers.—The Station's valuation of fertilizers is intended to represent the retail cost of the fertilizing elements as found in the raw materials before they are mixed. Retail prices at the consumers' depots are also published, and attention is called to the fact that the differences usually existing between these two prices may be due to expenses of mixing and bagging, estimated to average $2.85 per ton; freight rates, which should not exceed $2 per ton throughout the State, commissions, etc.

To make the trade in fertilizers satisfactory to both buyer and seller, the Station advises that, as far as possible, farmers study the wants of their own soils, and that they club together and buy early in the season, in comparatively large lots, for cash, and direct from reliable manufacturers. It is explained that because a brand reaches its guarantee in contained plant food, or corresponds closely in estimated value to selling price, its superiority to some other brands not reaching their claims in this respect is not necessarily established. The guarantee should be high enough to warrant the price, and the plant food such as is needed by the soil and crop. As a rule, the fertilizer richest in the needed elements is the cheapest, since the cost of manufacture, freight, and commission is the same for high-grade as for low-grade manures, and the labor of the farmer is increased as the grade of the goods decreases.

BULLETIN No. 57, JULY 31, 1889.

EXPERIMENTS WITH DIFFERENT BREEDS OF DAIRY COWS. G. H. COOK, LL. D. (pp. 2–8).—The board of managers of the Station appointed a committee September 15, 1888, to arrange for a series of trials of different breeds of dairy cows to determine the cost and value of the products from each breed. Requests were sent to cattle clubs in different parts of the country to co-operate with this committee by furnishing representative animals for use in these experiments. Notice was given that the breeds to be tested were Ayrshires, Guernseys, Holstein-Friesians, Jerseys, and Shorthorns, and that three animals of each breed would be selected.

" For animals approved by the several clubs, the Station agreed to pay $100 per head when safely delivered at the Agricultural College farm; to furnish proper shelter, food, and care; to make full and accurate records and reports of all experiments made; and to give ready and free access to the representatives of the clubs. The experiments in feeding, milking, weighing, measuring, etc., will be carried out on the farm of the Agricultural College, and the analyses of the food and milk will be made at the laboratory of the Agricultural Experiment Station, and they will probably extend over a period of from two to four years."

The clubs co-operating with the Station in these experiments are Ayrshire Breeders' Association, Brandon, Vt.; American Guernsey Cattle Club, Farmington, Conn.; Holstein-Friesian Association of America, Iowa City, Iowa; and American Shorthorn Breeders' Association, Chicago, Ill. Animals assumed to be representative were selected by committees from each of these clubs and the experiments were begun May 1, 1889. This bulletin contains a list of the cows, with descriptions, and their record for May, June, and July, including milk produced and weight of the cow at four different dates each month, and the weight of food consumed.

BULLETIN No. 58, AUGUST 5, 1889.

ANALYSES OF INCOMPLETE FERTILIZERS, G. H. COOK, LL. D. (pp. 3–11).—Analyses are given in tabular form of sixty-seven samples of incomplete fertilizers, *i. e.*, those containing but one or two of the fertilizing ingredients, nitrogen, phosphoric acid, and potash. The cost of nitrogen from nitrate of soda and sulphate of ammonia, and of potash from muriate and sulphate of potash, is found to be reasonably uniform; but in the case of phosphoric acid, from both bone-black and South Carolina rock, a range is noted of nearly 60 per cent in prices at different points. The cost of potash from kainit also shows a wide variation. The following statements bear upon the economy of buying "complete" or mixed *vs.* "incomplete" or unmixed fertilizers:

"Statistics secured by the station, and published in the annual report for 1888, showed that the average composition of mixed or complete fertilizers analyzed during the year was 2.77 per cent nitrogen, 8.09 per cent available phosphoric acid, 2.82 per cent insoluble phosphoric acid, and 4.29 per cent potash, and that the average selling price was $34.83 per ton; in other words, the nitrogen cost on an average 21 cents per pound, available phosphoric acid 10.2 cents, insoluble phosphoric acid 3.8 cents, and potash 5.4 cents. The same amount and kind of plant food could have been bought that year at the factory, unmixed and for cash, at an average price of $27.42 per ton. The average charge for mixing, freighting, and selling was, therefore, $7.41 per ton."

"Statistics in regard to the composition and cost of complete manures in 1888 showed that the average cost of the nitrogen contained in them was just one-third of their total cost. In the use of fertilizing materials, and especially of this most expensive element, nitrogen, great care should be exercised; and the use of unmixed materials, for studying the various soils and crops, is advised."

BULLETIN No. 60, OCTOBER 30, 1889.

ANALYSES OF GROUND BONES AND MISCELLANEOUS SAMPLES OF FERTILIZERS, E. B. VOORHEES, M. A. (pp. 2–11).—Analyses and calculated valuations are given in tabular form of seventy-five samples of ground bone, and seventeen other samples of "incomplete" fertilizing materials. The samples received at the station in 1889 were all of good character, and showed a decided improvement in mechanical condition over those examined in previous years. Ground bone is shown to be a cheap and valuable source of nitrogen and phosphoric acid. The demand for fertilizers quick in action tends to decrease the use of bones, and their special value in adding to soil fertility, while giving at the same time a profitable increase in yield, is often overlooked. Market garden produce and quick-growing field crops, as a rule, respond more profitably to quick-acting manures, and require the continued addition of smaller quantities of the more soluble and available elements of plant food. Fruit trees, permanent pastures, and meadows, on the other hand, while also responding to these, are further benefited by the addition of considerable quantities of materials which have a more lasting effect and furnish a gradual and continued supply of plant food. Well-ground bone, though insoluble in water, is readily decomposed by the action of the soil, and furnishes nitrogen and phosphoric acid to the crop in amounts proportionate to the fineness to which it is ground.

To determine the value of bones, the amount of nitrogen and phosphoric acid and the degree of fineness are taken into consideration. In the average per cent of fineness of the samples examined at the

Station in 1889, an increase of 20 per cent is shown in the finest grade and a decrease of 30 per cent in the coarsest grade, as compared with the bones analyzed in the four preceding years. The average selling price of twenty-four brands represented is $34.46 per ton; the average Station valuation is $35.55. The nitrogen of the complete fertilizers analyzed at the Station is derived chiefly from organic matter. Considering it to have come from materials as good as the finest form of bone, it is found to have cost 50 per cent more than the average cost of nitrogen in the finest bone. The average cost, for the year, of available phosphoric acid in complete fertilizers, which includes both the soluble and the reverted, is given as 9.9 cents per pound. The phosphoric acid in the finest bones—over 45 per cent of the samples analyzed—cost only 6.8 cents per pound.

The analyses of miscellaneous samples, consisting of dissolved bones, dried fish, superphosphates with potash, and plain superphosphatēs, showed that those brands in the hands of dealers are fine and dry and furnish nitrogen, phosphoric acid, and potash much cheaper than the average mixed or complete fertilizer.

Fish guanos show a high commercial valuation, and their guarantees, as a rule, were found to be kept. A sample of "phosphate meal," or "Peine-Thomas Scoria," sold at $25 per ton, contained 5.45 per cent available and 14.89 per cent insoluble phosphoric acid. In Germany, this material has been found to be a valuable source of phosphoric acid, and because of its low cost is widely used. The use of that produced here must depend largely upon its cost and the value of the phosphoric acid it contains.

BULLETIN No. 61, OCTOBER 31, 1889.

EXPERIMENTS WITH DIFFERENT BREEDS OF DAIRY COWS, M. E. GATES, PH. D. (pp. 3–11).—This is a report for August, September, and October, 1889, of the experiments explained in Bulletin No. 57 of this Station. In addition to the descriptions of the animals and records of food and product, tables are given "showing percentages of total solids contained in the milk of individual cows and in the mixed milk of herds for the months of August and September. The chief object in the limited chemical examinations was to secure data relative to the variations in quality of the milk from individual cows of the same breed." These variations were not marked, but seemed to be influenced by changes in atmospheric conditions and quality of green food supplied as affected by the extreme moisture of the season.

BULLETIN No. 62, NOVEMBER 6, 1889.

THE HORN FLY (HÆMATOBIA SERRATA), J. B. SMITH (pp. 3–40).—This contains an account of the author's observations on this insect, first noticed in this country in 1887, and a review of an extensive correspondence on the same subject. The life history and anatomy of the insect and its different stages are described in detail, and various remedies are suggested for its repression or destruction. The observations and conclusions in this bulletin should be compared with those from independent sources, recorded in Insect Life, Vol. II, No. 4 (pp. 93–103) and No. 6 (p. 165). The following is a popular description of the fly as given by Professor Smith:

> *Hæmatobia serrata*, R. Desv. The fly is about 4^{mm}, or rather more than one-sixth of an inch in length, of a dark, ash-gray color, with a faint yellowish tinge. To the ordinary observer they appear nearly black, and are generally so described in the letters received. The head is almost entirely taken up by the eyes, which are dark-red brown, deeper in color than that of the common house fly. The eyes are margined in the front by a narrow line of silvery white pile; the front is darker, and along each of the white borders is a row of long bristles curving over the front. The antennæ are small, two jointed, with a long pectinated or feathered bristle to the second joint. Below the antennæ can be seen the proboscis, usually carried straight forward and projecting a little in front of the head; accompanying this are the unusually long palpi, which are rather densely set with short, stiff hair. On the top of the head are three little ocelli, surrounded by stiff hair, and there is a fringe of stiff hair along the hind margin of the head. The thorax is crossed in front of the middle by a transverse impressed line, and at the posterior margin the triangular scutellum is separated off by another impressed line or suture. On each side of the middle is a concave, smooth, longitudinal impressed line or channel extending the full length of the thorax, and a little darker in color; nearer to each side is another such impressed line, also a little darker in color, giving the impression of four longitudinal darker lines on a deep gray ground. There is also on each side of the middle a black, crescent-shaped spot; the impressed lines are not set with hair, but there is a row of stiff hair at each side of the lines, and the surface is elsewhere rather densely clothed with stiff hair. The abdomen is small in proportion to the thorax, and is almost as broad as it is long, and flattened above. It is somewhat paler in color, and has a dusky median shade without distinct boundaries. The upper side is quite densely set with long, black, spinous hair.
>
> The legs are moderately long, blackish, the kneejoints marked with reddish, the whole quite densely set with stiff blackish hair.
>
> There is very little difference in appearance between the sexes, save that the abdomen of the female is more obese than in the male.

BULLETIN No. 63, DECEMBER 30, 1889.

TOMATOES—EFFECTS OF DIFFERENT METHODS OF MANURING, AND CHEMICAL COMPOSITION, E. B. VOORHEES, M. A. (pp. 3–27).

1. *Consideration of yields and maturity.*—The value of the annual tomato crop in New Jersey is computed to be over $1,000,000. At least 15,000 acres are cultivated to supply the 75 canneries in the State, and 2,000 for the general market. In view of the magnitude of the industry and the importance of understanding the effect of fertilizers upon the yield and time of ripening, a field experiment was made to study the effect of nitrate of soda upon early maturity and yield. It included tests of the effects of the nitrate when used in different quantities, in one application and in two applications, alone and with liberal amounts of phosphoric acid. Twelve plats were used, each one-twentieth of an acre in size. Nitrate was applied, *first*, alone (1) at the rate of 80 pounds per acre, on May 7; (2) at the

same rate, half May 7 and half June 12; (3) at the rate of 160 pounds per acre, on May 7; (4) at the same rate, one-half on each of the two dates named; *second*, in the same quantities and at the same times, but with the addition of muriate of potash and bone-black superphosphate, at the rate of 160 and 320 pounds per acre, respectively. The remaining four plats included one with superphosphate and potash salt, one with barn-yard manure, one with barn-yard manure and a "complete fertilizer" mixed, and one without manure. The experiment was conducted on the farm of C. M. Housell, an experienced and successful market gardener at Dunham's Corners, Middlesex County. The land was considered to be well adapted for experimental purposes. It consists of a sandy loam, is level, well drained, of uniform quality, and in a good state of cultivation. The plats were laid out and fertilizers applied by the chemist of the Station. The remainder of the work connected with the experiment was carefully done by Mr. Housell. Full notes were kept by him during the entire season, the Station receiving frequent reports, and the chemist visiting the experimental plats at least twice each month. An early variety of tomato was used, which had been developed by crossing leading varieties.

Conclusions.—The use of a small quantity of nitrate of soda in one application and of a large quantity in two applications increased the yield without delaying maturity. Large quantities in one application also increased the yield, but at the expense of maturity. Nitrate nitrogen is the ruling element in the growth of tomatoes, but its best effect is dependent on the method of application, and requires the presence in the soil of a full supply of the mineral elements, phosphoric acid and potash. The yield was increased from 35 to 60 per cent on the different plats by the use of nitrate of soda. There was a large profit in its use in every case, ranging from $17 per acre when it was used alone in the large quantity with one application, to $39 when it was used in the small quantity, in two applications in connection with phosphoric acid and potash.

2. *Consideration of chemical composition.*—The marked improvement in the edible and commercial qualities of the tomato since its introduction as a table food is believed to be due to changes in its chemical composition. Analyses were made of the tomatoes produced by the different methods of treatment to obtain information regarding the effect of nitrate of soda applied under different conditions upon the general classes of nutritive ingredients, fat, fiber, protein, and carbohydrates; the place of the tomato among edible products of similar character; and amounts of plant food removed by the tomato as compared with other crops.

The variations in composition of samples from the different plats are noticeable, but indicate the effect of nitrate of soda when used with or without the mineral elements, phosphoric acid and potash, rather than when applied at different times and in different quantities. It was observed that samples from the plats with nitrate and with farm manure were much more solid and had less seeds than those from the unmanured plat, or from that treated with potash and phosphoric acid without nitrate. The percentage of ash seems to have been considerably influenced by the use of nitrate, varying with the method of application. Tables are given of analyses of samples from each plat, of calculated amounts per acre of ash, nitrogen, phosphoric acid, and potash removed by the crop, as compared with other staple crops.

BULLETIN No. 64, DECEMBER 31, 1889.

SOME FUNGOUS DISEASES OF THE CRANBERRY, B. D. HALSTED, D. SC. (pp. 3–40). (illustrated).

Cranberry gall fungus (pp. 4–16).—An account of observations on a gall fungus found on cranberry and other plants in the Marian Bog near Browns Mill, Burlington County, N. J. The structure of gall is described and illustrated. The conclusions are, in substance, as follows:

The fungus (*Synchytrium vaccinii*, Thomas), sometimes called "red rust," infests certain cells in the leaf, stem, flower, or fruit, and causes abnormal outgrowths from the surface and finally ruins the crop. It is probably at present confined to a single cranberry bog, but may easily spread elsewhere. Several other shore plants belonging to the same family with the cranberry are also attacked, but only such of these as are bathed by water from the bog become infested. The disease is carried in the water by the floods of spring and is not readily transmitted through the air, but may be spread by birds and other animals, and by winds drifting the dead leaves of infested plants, like those of the huckleberry and azalea, over the snow crust in winter. Withholding the water from the bog during the winter and spring may subdue the fungus, but it would probably be a quicker and even cheaper way to burn the infested plants, including the infested shrubs along the borders and elsewhere.

Cranberry scald (pp. 16–40).—This includes a condensation of the reported experiences of some seventy leading cranberry growers in different States, together with the results of a microscopic examination of this disease. From the answers to a special bulletin of inquiry, which are tabulated and commented on, it appears that "the cranberry scald is confined for the most part to New Jersey, where it causes the loss of about one-third of the crop; it has been known for many years, and is much worse upon some bogs than others: the amount upon the same bog varies with the season, and is greater when moist, warm weather prevails. No application of lime, copperas, or other like substance proved an effective remedy, but in several cases sanding the bog or lowering the water lessened the scald." The microscopical examinations, which are described with illustrations, showed that "the trouble is primarily due to a minute fungus, found in all parts of the infested plant and also in the surrounding soil." This fungus seems to be closely related to the one which causes the black rot of the grape. Further investigations are needed, particularly in regard to the soil conditions favoring the growth of this disease, and the means of destroying the fungus without injuring the cranberry plants. For this work, which must largely be done on the bog, the Station desires the cooperation of those cranberry growers "who are willing to share in the labor and expense of a systematic search for a remedy."

SPECIAL BULLETIN F, JULY 26, 1889.

THE HORN FLY, J. B. SMITH (pp. 2, 3).—This contains brief preliminary notes on the horn fly, and a request to farmers to send information about this insect to the Station entomologist.

SPECIAL BULLETIN G, AUGUST 7, 1889.

THE POTATO ROT, B. D. HALSTED, D. SC. (pp. 2–4).—A brief, popular account of the fungus (*Phytophthora infestans*), the conditions favoring the rot, the treatment of infested fields, and preventive measures. Among the practical suggestions made are the following:

The rot is favored by moist and hot weather and will affect potatoes stored in damp, warm, and close cellars, as well as before digging. A loose, light soil does not promote the decay like a clayey one. The disease is undoubtedly often spread by the seed potatoes used. "If possible the potatoes for planting should be obtained from a locality where the rot has not prevailed." As a rule, the potatoes should be dug as soon as possible after the vines have been attacked by the rot. The diseased vines should be raked into heaps and burned to destroy the germs before the tubers are dug. Air-slaked lime, a handful or so per bushel, may be dusted over the freshly harvested potatoes to destroy any adhering germs.

SPECIAL BULLETIN H, AUGUST 28, 1889.

THE CRANBERRY SCALD, B. D. HALSTED, D. SC. (pp. 2, 3).—A list of questions "addressed to leading cranberry growers in various parts of the country."

SPECIAL BULLETIN I, OCTOBER 28, 1889.

QUESTIONS RELATING TO GENERAL FARM PRACTICE, E. B. VOORHEES, M. A. (pp. 2–8).—In view of the fact that farmers in New Jersey do not consider their business profitable under present conditions, the Station has prepared and sent out a list of questions to special and general farmers throughout the State to find out—"(1) Methods of rotation. (2) The proportion of stock kept to acreage. (3) The kind and quantity of food used per day. (4) The method of feeding and practice as to shelter. Definite information of this character will be of great importance, and will have an influence in determining and directing the lines of future experiments." The intention is to use data thus collected in connection with investigations by the stations, "with a view to aiding the farmers in the gradual adoption of a rational system of feeding, and to point out economic methods in the care and application of farm manures and the profitable utilization of waste farm products."

SPECIAL BULLETIN J, NOVEMBER 30, 1889.

THE SWEET-POTATO ROT, B. D. HALSTED, D. SC. (pp. 2, 3).—A list of questions "addressed to the leading sweet-potato growers of New Jersey" to obtain information on this subject.

NEW YORK.

New York Agricultural Experiment Station.

Location, Geneva. Director, Peter Collier, Ph. D.

BULLETIN No. 16 (NEW SERIES), JULY, 1889.

A STUDY OF THE CORN PLANT (pp. 117–121).—The rapidly growing use of corn silage is given as a reason for this preliminary report on the investigations of the corn plant in progress at the Station. The important problems with reference to corn for silage are stated to relate to the varieties to be grown, the methods of planting, and the proper maturity for harvesting. The experiment reported in this bulletin was to answer the question, "How much increase is there in a crop of corn intended for the silo during the later period of its growth?" For this purpose the crop on a field of about 2 acres, planted with Burrill and Whitman corn, was cut in two parts, as follows: Each alternate set of four rows was cut September 11 and the rest September 29. As fast as cut the corn was drawn to the barn, weighed, and put into the silo. Samples from different parts of the field were taken at each cutting and analyzed. The results, as stated in yields per acre for the different ingredients, may be summarized as follows:

Estimated yield per acre of total produce and of ingredients at different times of cutting.

	Cut September 11. Full silk to watery stage of kernels.	Cut September 29. Kernels in milky state.
	Pounds.	*Pounds.*
Ash	215	237
Protein	525	512
Crude fiber	1,443	1,650
Nitrogen-free extract:		
Glucose	580	751
Sucrose	390	634
Starch	909	1,077
Undetermined	817	611
Total	2,696	3,073
Fat	125	188
Total dry matter	5,004	5,660
Water	20,302	19,351
Total produce	25,306	25,011

The differences in the total yield, protein, ash, and fat, for the two dates, are doubtless within the limits of error in determinations, so that the real difference in the crop at the two cuttings is in the crude fiber and the constituents of the nitrogen-free extract, sugars, starch, etc. Among the other inferences are that, for the greatest amount of nutriment, corn should not be cut before the grain has reached the milk stage of the kernel. Whether this stage or a later one is best to secure the maximum of digestible matter must be found by further experimenting.

LUCERN, OR ALFALFA (pp. 121–129).—Here are given a brief history of this plant, statements of several experimenters regarding its value, analyses of alfalfa as compared with wheat bran and red clover hay, an account of a feeding experiment to test the digestibility of alfalfa, and notes on the preparation of the soil and methods of planting and curing with reference to this crop. The result of the Station's experience with alfalfa for seven years is thus summarized:

1. Lucern, or alfalfa, may be successfully grown in New York State.

2. When once established it thrives well upon clay land, but will probably do better upon good light loam.

3. Seed two years old loses its vitality and fails to germinate. Undoubtedly many of the failures to secure a stand of plants may be traced to poor seed.

4. The seed bed must be well prepared, and, in this latitude, it seems best to plant out the seed in the spring and with no other crop. The seed should be but lightly covered by rolling the ground.

5. For seven successive years at the Station three and four cuttings per year have been taken from the plats.

6. Last year, the sixth in succession, the plats yielded more than 15 tons per acre of green forage, equal to 5.6 tons of alfalfa hay.

7. Alfalfa should be cut in early bloom, before the plants become woody.

8. It should be cured largely in the cock to produce the best quality of hay.

9. By chemical analysis the hay was found to be more nitrogenous than good red clover.

10. Cattle, sheep, and horses all relished the hay and seemed to do well.

11. It was found to be more digestible than red clover hay.

12. If farmers would try this crop, we advise them to begin with a small piece of well-prepared land, in order to see whether alfalfa does as well with them as it has at the Station.

13. Probably success with alfalfa will depend largely upon having fresh seed, a good, carefully prepared seed bed, and in covering the seed lightly with soil.

BULLETIN No. 17 (NEW SERIES), OCTOBER, 1889.

CATTLE FOODS AND FEEDING RATIONS, P. COLLIER, PH. D. (pp. 131–156).—In the introduction it is stated that—

> New York State has one and a half million milch cows, probably producing on an average less than 3,000 pounds of milk per year; and the average annual butter product per cow for the State is undoubtedly less than 130 pounds. This should not be, when there are whole herds averaging 300 and some 400 pounds of butter per year for each cow. Animals producing these by no means phenomenal yields are not confined to any particular breed, and are often grades of our so-called native or no-breed animals. Proper selection, systematic breeding, and

judicious feeding have produced these profitable animals and herds. What has been accomplished by the few should be striven for by the many, and feed must be a prime factor in developing the ideal dairy animal or herd. Careful breeding and selection must hold the most prominent place, but breeding and selection, unless accompanied by good care and judicious feeding, will ultimately result in failure.

Tables and explanations show the chemical composition of feeding stuffs common in New York; the digestibility (by coefficients of digestibility of nutrients) as shown by American digestion experiments with domestic animals, and the proportions of digestible nutritive ingredients in cattle foods as calculated from the composition and digestibility. A conveniently arranged table shows the amounts of digestible materials in different quantities (1, 5, 10, 15, 20, 25, and 2,000 pounds) of a number of common feeding stuffs, thus furnishing the means for easily calculating daily rations. German feeding standards (Wolff's) are quoted, and the ways of calculating rations explained. Some nineteen daily rations for milch cows, "such as may be fed and often are fed by farmers," are given; the details showing the number of pounds of hay, straw, corn meal, wheat bran, cottonseed meal, and other materials in each, and the calculated amounts of digestible protein, fats, and carbo-hydrates; the nutritive ratio; the cost and the estimated money value of fertilizing materials, nitrogen, phosphoric acid, and potash. Some are well balanced, "according to the German standard or guides, while others are far from being well proportioned mixtures for milch cows."

An interesting feature of the bulletin is found in the descriptions of rations for milch cows actually fed by New York farmers. In December, 1888, a circular was sent to some fifty leading farmers of New York State, asking for information regarding rations fed by them. Only a few replied, and in some of the replies the data were not sufficiently complete to allow accurate calculations; but, from the reports, the quantities of food and of nutritive ingredients per day of ten of those rations are calculated and stated in the bulletin. Several of these are recapitulated herewith.

Kinds and amounts of feeding stuffs in daily rations.

Kinds.	1.	2.	7.	8.	10.	11.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Corn stover	10				13	
Corn silage	15	42.0		50		40
Sugar beets	10					
Corn meal	5	2.8	3	3		
Wheat bran	5	2.0	3	7		4
Ground oats	5					
Clover hay		9.6				
Mangolds		12.2				
Cotton-seed meal		3.66		3		2
Meadow hay			12	20	12	3
Linseed meal			3			
Oatmeal			3			
Straw					8	

Statistics of cows.—Nutritive ingredients of food and yields of milk or butter.

No.	Locality (in New York).	Breed of cows.	Cows in herd.	Average weight of cows.	Yield of milk per day.		Yield of butter per year.
					Summer.	Winter.	
				Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
1	Rochester	Mostly Guernsey	49	1,000	30	20	----------
2	Ithaca	Grade Holstein	12	1,122	----------	30	----------
7	Brockport	Jersey	12	----------	----------	----------	320
8	Leonardsville	Holstein-Friesian and Guernsey.	30	1,000	----------	----------	470
10	Cambridge	Brown Swiss	8	1,150	----------	----------	156
11	Holland Patent	Jersey, thoroughbred and grade.	11	----------	(*)	(*)	300

No.	Locality (in New York).	Breed of cows.	Nutrients in daily ration.				Potential energy (fuel value of nutrients of daily ration), Calories.	Nutritive ratio.
			Protein.	Fats.	Carbohydrates.	Total.		
			Pounds.	*Pounds.*	*Pounds.*	*Pounds.*		
1	Rochester	Mostly Guernsey	1.88	0.68	14.32	16.88	33,000	1: 8.4
2	Ithaca	Grade Holstein	2.57	1.12	10.21	13.90	28,490	1: 5.0
7	Rockport	Jersey	2.03	0.63	10.03	12.69	25,090	1: 5.6
8	Leonardsville	Holstein-Friesian and Guernsey	3.01	1.27	17.21	21.49	42,970	1: 6.7
10	Cambridge	Brown Swiss	0.85	0.28	12.61	13.74	26,220	1:15.6
11	Holland Patent	Jersey, thoroughbred and grade.	1.52	0.71	6.59	8.82	18,080	1: 5.4
German standard for milch cows per day for 1,000 pounds live weight.			2.50	0.40	12.50	15.40	29,590	1: 5.4

* 5,000 pounds per year.

[As the figures for potential energy were not given in the bulletin, but were added in the abstracting in this Office, a word of explanation seems called for. In being consumed in the body as fuel to furnish heat and muscular energy the nutrients appear to replace one another in proportion to their potential energy, which is accordingly taken as a measure of their fuel value. The energy may be estimated in units of either heat or mechanical power. For heat unit the Calorie, and for amount of mechanical energy the foot-pound or foot-ton, is commonly used. The Calorie is the heat which would raise a kilogram of water 1 degree Centigrade (or 1 pound of water about 4 degrees Fahrenheit). A foot-ton is the energy (power) which would lift 1 ton 1 foot. One Calorie corresponds to 1.53 foot-tons. A gram of digestible protein or a gram of digestible carbohydrates is assumed to yield 4.1 and a gram of fats 9.3 Calories. A given weight of fats is thus taken to be equivalent in fuel value to 2.27 pounds of protein or carbohydrates. The figures for potential energy in the table are calculated for each food material by multiplying the number of grams of protein and of carbohydrates in 1 pound by 4.1, and the number of grams of fat by 9.3, taking the sum of these three products as the number of Calories of potential energy in a pound of the material. The computation is made more convenient by taking each per cent of each ingredient as equivalent to one hundredth of a pound of that ingredient in a pound of the feeding stuff and multiplying by the number of Calories in 0.01

pound. As 0.01 pound equals 4.536 grains, 0.01 of a pound of protein or carbohydrates would thus be assumed to yield (4.536×4.1=) 18.6, and each 0.01 pound of fats 42.2 calories.

The quantities of digestible protein in the daily food per cow vary from nine-tenths of a pound to 3 pounds, the total digestible nutrients from 8¾ to 21½ pounds, the fuel value from 18,000 to 43,000 calories, and the nutritive ratio from 1:5.4 to 1:15.6. Such a wide range in the feeding practice of New York dairymen certainly shows the need of thorough study of this subject.

This method of estimating the fuel value of feeding stuffs has been adopted tentatively for some of the publications of this Office. The subject will be referred to briefly in a monograph on the feeding of swine and in a bulletin on the composition and nutritive values of American feeding stuffs, now being prepared for publication by this Office. It will suffice to say here that the calculations are based upon late German experiments with the respiration apparatus and the calorimeter. The more important experimental data may be found in articles by Stohmann, *Landw. Jahrbücher*, 13, 513, and *Jour. f. Prac. Chem.*, N. F., Bde. 19–40 *passim*, and by Rubner, *Zeitsch. f. Biologie*, Bde. 21–25 *passim*. The principal points are explained in an article by the undersigned in the Century Magazine for July, 1887. Investigations with the calorimeter on the potential energy (heats of combustion) of organic compounds, vegetable and animal, are being conducted in connection with the Storrs Experiment Station.—W. O. ATWATER.]

BULLETIN No. 18 (NEW SERIES), NOVEMBER, 1889.

TESTING OF DAIRY BREEDS, P. COLLIER, PH. D. (pp. 157–198).—"New York is the leading dairy State of the Union. The annual report of the Department of Agriculture for 1888 gives the number of milch cows in New York, January 1, 1889, as 1,552,373, valued at $45,950,241. Iowa stands next in the list, with 1,293,095, valued at $28,861,880. The dairy products of the State are estimated at $44,000,000, and the aggregate capital invested in dairying in this State, including value of animals, land, dairy buildings, and implements, has been estimated as high as $400,000,000." In view of the great importance of the dairy interest, this Station has undertaken a series of feeding experiments in accordance with a plan outlined in a circular sent to leading breeders of cattle throughout the country, who were asked to aid the Station in securing most economically the animals used for the experiments. The main features of the plan referred to are as follows: At least four representative animals, two heifers and two steers, of the Jersey, Holstein, Guernsey, Ayrshire, Shorthorn, Devon, and one or two of the polled breeds under one year old, should be selected. The two heifers of each breed would be the beginning of a herd for the study of "the breed characteristics in production of milk and butter. Two steers from each breed, fed and grown to maturity and fattened, would show much as to the relative values of the dairy breeds for beef." The questions to be studied should include the yearly growth of the animals under like conditions and feeding, and the amount of food consumed in proportion to live weight for the several breeds: breed characteristics for production of milk and butter and for beef; the relative profitableness of small and large cows; "whether two foods of similar composition will affect equally the milk and butter yield, or whether one will tend more to the production of body fat and less to an increase of milk;" and "the influence of various grains fed separately and combined in rations, and to what extent the chemical and physical properties of butter are influenced by different foods."

This plan met with cordial approval from individual and associated breeders. "The legislature also, recognizing the practical value of the proposed investigation, made liberal appropriation for a barn suitable for the purpose of the experiment, and ample and convenient arrangements have been made for twenty-four animals, besides four box stalls and five stalls for bulls." A list of the animals already obtained by the Station includes six Holstein-Friesians, five Ayrshires, four American Holdernesses, four Guernseys, and four Jerseys. "It is proposed to increase the herd gradually and broaden the work, until the accumulated data shall be such as to carry conviction to everyone who shall carefully consider the results obtained."

This bulletin contains the six months' record of a feeding experiment begun April 1, 1889, with thirteen heifers, including four Holstein-Friesians, four Ayrshires, two American Holdernesses, two Guernseys, and one Jersey. The feeding stuffs used were hay of mixed grasses and clover; sugar-beets; green forage, including alfalfa (much relished), rye (not relished), maize, oats, peas, and Hungarian grass (on which the animals did not seem to do well); wheat bran; linseed meal (old process); crushed oats; wheat middlings; corn meal. Tables filling about thirty pages give for each animal the age in days April 1, 1889; date of receipt of animal at Station; the average weight for the last five mornings of each month; the total amount of water and of each kind of feed consumed per month, and the daily average during each month, together with the corresponding amounts of the chemical constituents of the food; and for each breed for each month the amount of water drunk, the amount of each chemical constituent in the feed consumed, the live weight, average monthly gain, dry matter consumed for each pound of increase, and the dry matter eaten per 1,000 pounds of live weight. An interesting observation regarding the pounds of dry matter required for one pound of gain is brought out in one of the tables and stated as follows: "In June more dry matter was required than in May, and the largest amount in July, averaging more than three times as much for the month of July as for May; or as 4.1 to 14.1. In August less dry matter was required for one pound of gain than in July, while the month of September approximated the month of June. While feeders have recognized this fact, I believe these are the first trials to determine the real difference in favor of so arranging our system of feeding as to take advantage of the spring and autumn months for fattening animals." It is intended to continue the experiment and report results every six months. The results of the feeding trials with growing and fattening animals will also be reported. More complete details will be given in the annual reports of the Station.

Cornell University Agricultural Experiment Station.

Department of Cornell University.

Location, Ithaca. Director, Isaac P. Roberts, M. Agr.

BULLETIN No. 7, JULY, 1889.

ON THE INFLUENCES OF CERTAIN CONDITIONS UPON THE SPROUTING OF SEEDS, L. H. BAILEY, M. S. (pp. 31-71), (illustrated).—In the investigations reported in this bulletin, "with the exception of studies of the relation of weight and color to sprouting, only the conditions of germination have received attention." The fact that these conditions have been too little regarded in the testing of seeds is emphasized, and the need of more thorough researches to determine the best methods of seed testing is urged. "The importance of seed testing is obvious, yet its value is commonly misapprehended. Its primary value is the determination of the vitality of a given sample. This testing, except in rare instances, should be conducted by the grower himself. The proper work for the experiment station is that of determining the best methods and conditions of testing each species and variety: in other words, it seems that the sphere of the stations is to discover and announce laws and rules, rather than to perform the petty tests for the multitude."

The general conclusion is that there is no need for seed control stations in this country, at least for garden seeds, to which, it should be noticed, the investigations here reported were confined. The apparatus used in making the tests is described and illustrated. The investigations covered the following points:

(1) Influences of constant and variable temperatures upon sprouting. Tests made in an incubator at temperatures ranging only 3 degrees were compared with those in a forcing-house at widely ranging temperatures.

(2) Influences of different quantities of water upon sprouting.

(3) Influences of the soaking of seeds before sowing.

(4) Influences of character of soil upon sprouting. Potting soil was compared with sand for beans.

(5) Influences of light upon the sprouting of seeds. Seeds were sown on the surface of soil in pots or pans, which were then covered with a pane of glass or an iron saucer or a board.

(6) Weight of seeds in relation to sprouting.

(7) Color of seed in relation to sprouting. For example, white beans compared with green: white morning-glory seeds with black.

(8) Influences of latitude upon sprouting. Corn from South Carolina and Alabama was compared with that from Ithaca, N. Y.

(9) Variations in duplicate tests under like conditions.

(10) Comparisons of results of seed tests with results of actual sowing in the field.

(11) Impurities in samples of garden seeds. Over 100 packages were examined, for 90 of which the results were tabulated and compared. "No evidence of adulteration was found, and weed seeds were few and unimportant." "The impurities were very largely immature and imperfect seeds." They averaged by number 2.76 per cent, and by weight 1.38 per cent.

General summary.—1. The results of a seed test depend very largely upon the known conditions under which the test is made:

(1) Variations in temperature may cause variations in rapidity of sprouting.

(2) An essentially constant temperature of about 74° gives quicker results than an ordinarily variable temperature of a similar mean.

(3) Probably any constant temperature gives quicker results than a variable temperature of which the mean is the same as the constant temperature.

(4) As the mean temperature lowers, sprouting, as a rule, becomes slower.

(5) In some instances greater rapidity of sprouting, due to a constant temperature of 74°, does not appear to be correlated with greater per cent of total sprouting. In beans, however, greater per cent of sprouting appears to follow greater rapidity of sprouting.

(6) There is probably a tolerably well-defined optimum temperature for each species of plant, in which best results from seed tests can be obtained. This limit is not closely determined for most garden seeds.

(7) The quantity of water applied to seeds may determine both the rapidity and per cent of sprouting.

(8) A comparatively small amount of water gives quickest and largest results.

(9) Greater quantities of water than are required for best results lessen rapidity and per cent of sprouting, either by causing the seeds to rot or by retarding germination, or by both.

(10) The soaking of seeds in water before planting does not appear to hasten sprouting if the planting time is reckoned from the time at which the seeds are put to soak. But if planting time is counted from the time of placing the seeds in soil, quicker sproutings are the result. This method is incorrect, however.

(11) Soaking of seeds does not appear to influence amount of sprouting.

(12) The results of soaking appear to vary in different species.

(13) The character of soil in which the test is made may influence the results, both in rapidity and per cent of sprouting.

(14) Light has great influence upon the sprouting of the seeds of some species.

(15) When light has any influence it retards or wholly prevents sprouting.

(16) The effects of light upon sprouting are different in different species.

(17) The weight of the seed is often a tolerably accurate measure of its viability, as determined both by rapidity and per cent of sprouting.

(18) As a rule, heavy seeds germinate better than light ones.

(19) Seeds of different species may vary in sprouting in reference to weight.

(20) The color of the seed in some cases is a tolerably accurate measure of rapidity and per cent of sprouting.

(21) When there is any variation in viability in reference to color, it is usually found that the stronger sproutings occur in the darker colored seeds.

(22) The relative values of seeds of different colors vary with each species, or sometimes with each sample.

(23) The latitude in which seeds are grown may determine their behavior in germination.

(24) Northern-grown corn appears to germinate quicker than Southern-grown corn. It is to be expected, from our knowledge of the variation of plants in reference to latitude, that seeds of most species will give similar results.

(25) Variation in results of seed tests may be due to the apparatus in which the test is made.

(26) Apparatus in which the seeds are exposed to light are to be distrusted.

(27) Apparatus which afford no protection to the seeds other than a simple layer of cloth, paper, board, or similar cover, are usually unsafe, from the fact that they allow of too great extremes in amounts of moisture.

(28) The so-called Geneva tester appears to give better results of sprouting than tests made in soil, probably from the fact that moisture and temperature are less variable than in the soil tests.

(29) To study germination to its completion, tests must be made in soil.

(30) Tests made in-doors are more reliable than those made in the field.

2. Results commonly vary between tests made under apparently identical conditions, even with selected seeds. Therefore,

(31) One test can not be accepted as a true measure of any sample of seeds.

3. The results of actual ordinary planting in the field can not be considered a true measure of the viability or value of any sample.

4. Rapidity of sproutings, unless under identical conditions, is not a true measure of vitality or vigor of seeds.

5. There appears to be no pernicious adulteration of garden seeds in this country, and as a rule there are no hurtful impurities.

In the ordinary farmer's garden seed testing is perhaps of little or no value, but to the market gardener, who plants considerable areas to special crops, and to the seedsman, it is highly profitable. It is possible that in some cases the character of the crop can be prognosticated with some degree of certainty from behavior of plants in germination, wholly aside from percentages of sprouting. The studies of experts in this country and Germany indicate that when accurate information is desired as to the value of seeds the seed test should present at least the following data: Name of variety, where grown, when grown, how kept, per cent by weight of foreign matter, per cent by weight of apparently good seeds, nature of foreign material, weight of seeds, manner of testing, number tested, average and extreme temperatures during trial, first germinations in hours, last germinations in hours, per cent by number germinated, per cent unsprouted but sound at end of trial, date of test, estimate of agricultural value.

BULLETIN No. 8, AUGUST, 1889.

THE EFFECT OF DIFFERENT RATIONS ON FATTENING LAMBS, I. P. ROBERTS, M. AGR., AND H. H. WING, B. AGR. (pp. 75–86).—"These experiments were, in the main, a continuation of those carried on at this Station one year ago, and reported in Bulletin No. 11, and very nearly the same foods were used, none of them being out of the reach of the general mass of farmers." The period of feeding lasted five full months, from November 25, 1888, to April 25, 1889. Twelve lambs in four lots of three each were used, but for reasons stated in the bulletin the computations of results are based upon the two heaviest lambs in each lot. The lots were numbered respectively III, IV, V, and VI. Lot III received what may be called a "carbonaceous" ration, consisting of timothy hay, whole corn, and roots; lot IV, a nitrogenous ration, consisting of clover hay, roots, wheat bran, and cotton-seed meal; lot V, an "intermediate" ration, consisting of timothy hay, roots, corn, wheat bran, and cotton-seed meal: and lot VI the same as lot V, except that they received no roots. The ration of lot III was considerably richer in carbonaceous matter than that of lot II of last year, while the ration of lot IV was not so rich in protein as that of lot I of last year. In this experiment, as in that of 1888, a very much larger amount of water was drunk by the lambs fed the nitrogenous rations. Lot III drank 308 pounds, or 1.03 pounds per lamb per day. Lot IV drank 1,185 pounds, or 3.95 pounds per lamb per day. Lot V drank 735 pounds, or 2.45 pounds per lamb per day. Lot VI drank 847 pounds, or 2.82 pounds per lamb per day.

The total number of pounds, cost, and number of pounds of protein, nitrogen-free extract, fiber, and fat for each material in the rations consumed by the several lots and the gain in live weight in pounds and in per cent for each lamb in each lot are given in tabular form. The amount of gain in live weight in relation to the amount and cost of food consumed by each lot is shown in the following table:

Gain in live weight in relation to amount and cost of food.

	III.	IV.	V.	VI.
Digestible carbonaceous food consumed .... pounds	296.20	288.08	328.56	299.75
Digestible nitrogenous food consumed .... do	29	75.88	54.71	51.73
Total digestible nutrients consumed .... do	325.20	363.96	383.27	351.48
Nutritive ratio	1:10.9	1:4.2	1:6.5	1:6.3
Total gain in weight (both lambs) .... pounds	48.65	77.31	75.13	57.69
Pounds nutrients consumed for 1 pound gain	6.67	4.71	5.10	6.09
Total cost of food consumed	$3.70	$4.66	$4.78	$4.51
Cost of gain per 100 pounds	$7.59	$6.03	$6.36	$7.82

It will be observed that "both in the items 'Amount of food consumed for one pound of gain,' and 'Cost of gain per 100 pounds,' the advantage is very markedly in favor of lot IV—the lot fed on nitrogenous food. It cost us a little more than a cent and a half per pound, or 26 per cent to put a pound of gain upon our lambs that were fed on corn, timothy hay, and roots, than it did to put a pound of gain on those that were fed wheat bran, cotton-seed meal, clover hay, and roots."

The lambs were shorn November 15 (ten days before the beginning of the experiment), and again on April 24, so that the wool obtained was the growth of one hundred and sixty days.

"The weight of the wool from both lambs in each lot was as follows:

Lot.	Weight.	Increase over lot III.
	Pounds.	*Per cent.*
Lot III	4.25	....
Lot IV	7.31	72
Lot V	6.63	56
Lot VI	6.19	46

"This coincides with the results of our experiments last year, in that nitrogenous food seems to largely affect the growth of wool. It seems to show further that even a small increase in the nitrogenous matter of a ration has a decided influence on the growth of the wool."

"In the experiments of 1888 the percentage was not so great in favor of the lambs fed on nitrogenous food. In experiments of 1889, lot IV gave 72 per cent more wool than lot III. In experiments of 1888 lot I gave 55 per cent more wool than lot II." The weights of the dressed carcasses, and the various organs for each animal, and the averages for each lot, are also stated in tables. "In the proportion of dressed to live weight is to be found the main discrepancy between the experiments of 1888 and 1889. Last year the dressed weight of the nitrogenous-fed lambs was 9 per cent greater than those fed carbonaceous food. This year the difference was about as much in the other direction."

The following parts and organs were greater by the following percentages in proportion to the live weight:

In 1889, (1) in the lambs fed on nitrogenous food: Wool 44, kidneys 18, blood 19, heart 40, liver 13, lungs 18; (2) in the lambs fed on carbonaceous food, dressed weight 13, caul fat 242, kidney fat 198.

In 1888, (1) in the animals fed on nitrogenous food: Dressed weight 9, wool 26, caul fat 13, kidneys 13; (2) in the animals fed on carbonaceous food, heart 26, blood 9, liver 4, lungs 8.

Summary.—"The weight of evidence of all of our experiments, together with results obtained by other experimenters in the same field, seem to show:

"That corn, as an exclusive grain ration, does not give the best results, either in amount, quality, or economy of production, when fed to growing or fattening animals.

"That the amount of water drunk (especially in the case of our lambs) is a pretty certain indication of the rate of gain.

"That the production of wool is very greatly dependent upon the nitrogen in the ration."

Manurial value of the rations.—On the supposition that 80 per cent of the manurial value of the food is recovered in the manure, the manurial value of the ration of each lot would be as follows, reckoning nitrogen at 17 cents per pound, phosphoric acid at 7, and potash at 4½:

Lot.	Cost of ration.	Manurial value.	Cost of ration less value of manure.
Lot III (Carbonaceous)	$3.70	$1.12	$2.58
Lot IV (Nitrogenous)	4.66	3.56	1.10
Lot V (Intermediate, with roots)	4.78	2.10	2.68
Lot VI (Intermediate, without roots)	4.51	1.97	2.54

This table shows "that while the first cost of the ration of the nitrogenous-fed sheep was larger than that of the carbonaceous, yet when the value of the manure is subtracted the cost of the former is less than half of the latter."

BULLETIN No. 9, SEPTEMBER, 1889.

A STUDY OF WIND-BREAKS IN THEIR RELATIONS TO FRUIT GROWING, L. H. BAILEY, M. S. (pp. 91–110), (illustrated).—This embodies the results of much experience and observation on this subject, including the information derived from inquiries addressed in 1889 to a large number of leading fruit growers in New York and Michigan. The subject is treated under the following heads:

(1) Influences of wind-breaks upon fruit plantations.

(2) Proper location of wind-breaks, and manner of making them.

The experience and observation of forty-three observers favorable to wind-breaks are summarized in tables, giving the site and soil of orchard, direction of prevailing or severest wind, location in reference to large bodies of water, kinds of fruit grown, kind of wind-break used, and benefits derived. Similar data are recorded from fourteen reports which were unfavorable to wind-breaks. The bulletin is illustrated with three cuts of as many kinds of wind-breaks.

General summary.—(1) A wind-break may exert great influence upon a fruit plantation.

(2) The benefits derived from wind-breaks are the following: protection from cold; lessening of evaporation from soil and plants; lessening of windfalls; lessening of liability to mechanical injury of trees; retention of snow and leaves; facilitating of labor; protection of blossoms from severe winds; enabling trees to grow more erect; lessening of injury from the drying up of small fruits; retention of sand in certain localities; hastening of maturity of fruits in some cases; encouragement of birds; ornamentation.

(3) The injuries sustained from wind-breaks are as follows: Preventing free circulation of warm winds and consequent exposure to cold; injuries from insects and fungous diseases; injuries from the encroachment of the wind-break itself; increased liability of late spring frosts in rare cases.

(*a*) The injury from cold, still air is usually confined to those localities which are directly influenced by large bodies of water, and which are protected by forest belts. It can be avoided by planting thin belts.

(*b*) Injury from insects can be averted by spraying with arsenical poisons.

(*c*) The injury from the encroachment of the wind-break may be averted by good cultivation and by planting the fruit simultaneously with the belt.

(4) Wind-breaks are advantageous whenever fruit plantations are exposed to strong winds.

(5) In interior places, dense or broad belts, of two or more rows of trees, are desirable; while within the influence of large bodies of water, thin or narrow belts, comprising but a row or two, are usually preferable.

(6) The best trees for wind-breaks in the Northeastern States are Norway spruce and Austrian and Scotch pines, among the evergreens. Among deciduous trees, most of the rapidly growing native species are useful. A mixed plantation, with the hardiest and most vigorous deciduous trees on the windward, is probably the ideal artificial shelter belt.

BULLETIN No. 10, OCTOBER, 1889.

NOTES ON TOMATOES, L. H. BAILEY, M. S. (pp. 113–126), (illustrated).—This includes a statement of the general results of investigations covering several years, together with tabulated reports on tests made in 1889 and notes on some of the newer varieties. Especial attention is paid to transplanting, time of sowing the seed, and manuring. Experiments were made to find a reliable method of determining the relative solidity of the fruit, the relation of solidity to keeping qualities, and the cooking qualities of different varieties as shown by the time required for cooking and the amount of shrinkage. The results were chiefly valuable as indicating the unsatisfactory nature of the tests usually applied. Emphasis is laid on the fact that very few of the numerous varieties of tomatoes offered for sale possess superior merit for general culture. The following summary is taken from the bulletin:

(1) Frequent transplanting of the young plant, and good tillage, are necessary to best results in tomato culture.

(2) Plants started under glass about ten weeks before transplanting into field gave fruits from a week to ten days earlier than those started two or three weeks later, while there was a much greater difference when the plants were started six weeks later. Productiveness was increased by the early planting.

(3) Liberal and even heavy manuring, during the present season, gave great increase in yield over no fertilizing, although the common notion is quite to the contrary. Heavy manuring does not appear, therefore, to produce vine at the expense of fruit.

(4) The tests indicate that poor soil may tend to render fruits more angular.

(5) Varieties of tomatoes run out, and ten years may perhaps be considered the average life of a variety.

(6) The particular points at present in demand in tomatoes are these: regularity in shape, solidity, large size, productiveness of plant.

(7) The ideal tomato would probably conform closely to the following scale of points: Vigor of plant, 5; earliness, 10; color of fruit, 5; solidity of fruit, 20; shape of fruit, 20; size, 10; flavor, 5; cooking qualities, 5; productiveness, 20.

(8) Solidity of fruit can not be accurately measured either by weight or keeping qualities.

(9) Cooking qualities appear to be largely individual rather than varietal characteristics.

(10) The following varieties appear, from the season's work, to be among the best market tomatoes: Ignotum, Beauty, Mikado, Perfection, Favorite, Potato Leaf.

(11) The following recent introductions appear to possess merits for market: Bay State, Atlantic, Brandywine, Jubilee, Matchless, and perhaps Lorillard, Prelude, and Salzer.

(12) The following recent introductions are particularly valuable for amateur cultivation: Dwarf Champion, Lorillard, Peach, Prelude.

BULLETIN No. 11, NOVEMBER, 1889.

ON A SAWFLY BORER IN WHEAT. J. H. COMSTOCK, B. S. (pp. 127–142). (illustrated).—This contains a detailed account of the European corn sawfly (*Cephus pygmaeus*), found in great abundance on the University farm, though not previously recorded in this country. The adult insects appear early in May, and the females oviposit about the middle of the same month, chiefly in the upper portion of the straw. "The egg is pushed entirely through the wall of the straw and left adhering loosely to the inside." "The eggs hatch soon after they are laid, and the larvæ may develop quite rapidly." As the grain becomes ripe the larvæ tunnel their way through the joints of the stalk toward the ground, and by harvest time very many of them have penetrated to the root. They then cut the straw circularly on the inside about an inch above the ground, filling the cavity just below the cut with a plug of borings. Immediately thereafter a cocoon of silk is spun, in which the insect passes the winter. The chief injury caused by these insects was the lodging of the grain. It was found by trial that "in most cases the grain shelled from a certain number of infested heads weighed more than the grain shelled from the same number of noninfested heads taken from the same bundle in regular order after the infested ones had been removed." This is explained on the theory that, since oviposition takes place early, the more vigorous stalks, which are largest at that time, are chosen. The insect was only observed to infest wheat at Ithaca, N. Y., but is probably not confined to that locality. If the stubble is burned or plowed under in the autumn the insects will be destroyed.

BULLETIN No. 12, DECEMBER, 1889.

A NEW APPARATUS FOR DRYING SUBSTANCES IN HYDROGEN AND FOR THE EXTRACTION OF THE FAT, G. C. CALDWELL, PH. D. (pp. 147–150).—The apparatus is described and illustrated by figures. The reason of the demand for it and its fitness for its purpose are thus stated: "At the last meeting of the Association of Official Agricultural Chemists it was voted that in the analysis of cattle foods the substance should be dried, for the determination of moisture and ether extract, in a current of dried hydrogen at the temperature of boiling water, and that the glass containing the substance should not come in contact with the water. * * * The form of drying bath and tube shown seems to meet the requirements fully, while at the same time it makes it also possible to carry the hydrogen directly through the substance instead of over it, as is usually done, thus securing more rapid drying; to weigh the substance before and after drying in a perfectly tight tube; and to use one and the same portion of the substance for the three determinations, moisture, ether extract, and fiber, without inconvenience and without any danger of loss of substance in the single transfer from one vessel to another that is necessary. It is also easy to heat the hydrogen to the temperature of boiling water before conducting it through the substance, a modification that seemed desirable to some members of the association."

The apparatus consists of a rectangular copper bath, with a copper tube passing obliquely downward through it to hold glass drying tubes. The latter are open at both ends and fitted with two sets of stoppers, one set closing the tube tight for weighing and one with tubulures for passage of the stream of hydrogen in drying. Projections on the inside of the tube near the lower end sustain a perforated platinum cone, which is overlaid with a mat of asbestos and sustains the substance. After the drying, the tube with contents is placed inside an extraction apparatus for the determining of ether extract. The extracted material is used for determination of crude fiber. Observations with a thermometer, when water boiled at 100, showed the same temperature inside the tube when the substance was being dried in hydrogen, but a temperature of 101 when it was dried in a current of air, the conditions being otherwise the same. The higher temperature was apparently due to oxidation of the substance.

BULLETIN No. 13, DECEMBER, 1889.

On the deterioration of farm-yard manure by leaching and fermentation, I. P. Roberts, M. Agr., and H. H. Wing, B. Agr. (pp. 153–160). (illustrated).—During the summer of 1889 investigations were made in this general subject in three main directions, viz: (1) What loss does horse manure suffer when thrown out in a pile unsheltered from the weather? (2) What loss does mixed farm-yard manure suffer when piled in a close pile so that fermentation is very slow, but without protection from rainfall? (3) Is there any appreciable loss of valuable matter when manure simply dries without fermentation?

(1) The manure of one day (excrement, solid and liquid, 491 pounds, bedding 38.5 pounds, total 529.5 pounds) from nine horses was exposed for six months out of doors in an open wooden box, which was not water-tight, and was placed in a pile of manure, the object being to subject its contents to the same conditions that prevail when horse manure is thrown out in a loose pile from a stable door. At the end of this time the composition of the exposed manure, as compared with that of fresh manure, was as follows:

Description.	Water.	Nitrogen.	Phosphoric acid.	Potash.	Total weight of manure.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds.*
Fresh horse manure.*	70.79	0.51	0.21	0.53	529.5
Horse manure after having been exposed six months	81.74	.46	.15	.31	372

The losses, therefore, were threefold: first, a considerable loss in the total weight; second, a gain in the percentage of water; and third, a loss in the percentage of valuable fertilizing elements.

The commercial value of the nitrogen, phosphoric acid, and potash in a ton of the fresh manure is estimated to be $2.45; while the same ingredients in the manure which had been exposed six months would be worth $1.42, showing a loss of $1.03 per ton, or 42 per cent.

(2) A block of mixed horse and cow manure, from the covered yard underneath the University barn, which had been well packed by the animals treading upon it, was exposed to the weather for six months in a galvanized-iron box "with a perforated bottom so arranged that

the leachings were caught below in a pail." Analyses of the leachings and of the manure at the close of the experiment showed a loss of 3.2 per cent of nitrogen, 4.7 per cent of phosphoric acid, and 35 per cent of potash. Reckoning the value of a ton of the mixed manure at $2.38, the loss by leaching in this experiment was 22 cents per ton, or 9.2 per cent.

(3) Two samples of manure like that used in the experiment just referred to, when spread out thinly in iron pans and dried out of doors (exposed to the sun and air but protected from rain), showed no appreciable loss of fertilizing constituents.

The following summary is taken from the bulletin: "The results of one season's trial seems to show that horse manure thrown in a loose pile and subjected to the action of the elements will lose nearly one-half of its valuable fertilizing constituents in the course of six months; that mixed horse and cow manure in a compact mass and so placed that all water falling upon it quickly runs through and off is subjected to a considerable, though not so great a loss, and that no appreciable loss takes place when manure simply dries."

Reference is also made to similar experiments at the Kansas Station from which the following conclusion was drawn: "The moral which the experiment plainly emphasizes is, that farm-yard manures must be hauled to the field in the spring; otherwise the loss of manure is sure to be very great, the waste in the course of six months amounting to fully one-half the gross manure and nearly 40 per cent of the nitrogen that it contained." Engravings from photographs of the covered yard of the University barn and of two ordinary uncovered barn-yards, as they exist in New York, serve to illustrate the need of greater carefulness in the preservation of manure. "Attention is particularly directed to the watery, miry condition of the uncovered yards and to the heaps of manure under the eaves."

ON THE EFFECT OF A GRAIN RATION FOR COWS AT PASTURE. I. P. ROBERTS, M. AGR., AND H. H. WING, B. AGR. (pp. 161–167).—"It is generally recommended that cows at pasture in the summer should have a supplementary grain ration, and a large number of the more progressive farmers pursue this practice with an evident belief that it is profitable. In the absence of data as to the value of this practice it was deemed worth while to conduct as carefully as might be a somewhat extended experiment, intended to afford, if possible, some light on the point in question."

For this purpose six cows were used in "two lots mated in pairs as nearly alike as was possible in age, breeding, time since calving, yield of milk, and time to next calving." "Lot 1 received only the grass in the pasture. Lot 2 received besides the pasture a grain ration of two pounds of cotton-seed meal and two pounds of wheat bran per cow per day, fed in two equal feeds morning and night."

The period of feeding extended fifteen weeks (from June 8 to September 21, 1889). The results are recorded in tabular form, including the average yield of milk in pounds per cow per day for each week, and the average per cent of solids and of fat for the last three days of each week, together with averages of these data for three periods of four weeks each, and one period of three weeks. Reference is made to an experiment with similar results at the Kansas Station. (See Annual Report of Kansas Station for 1888, p. 69.)

"The tables show that there was a steady and constant diminishing in the flow of milk of both lots, but that lot 2 fell away in their milk yield much more rapidly than lot 1. At the same time, if we except the last two weeks (of which mention will be made later), the milk of lot 2 showed a constant and considerable increase in percentage of fats while that of lot 1 remained very nearly stationary. For this reason there was very little difference in the total amount of fat produced by the two lots."

"While we received no return in milk and butter for the extra grain fed, we should scarcely want to say that the grain was fed at a loss, for two reasons: First, there must have been a considerable saving in pasture; in other words, we should have been able to keep a larger number of cows in the same pasture. Second, the manurial value of the grain at present prices of fodders and fertilizers, would go far toward balancing its cost." Attention is called to the fact that climatic conditions may have influenced the results. The season was unusually rainy, and it was observed that during the period of the least rainfall and the highest temperature, when the conditions approached those of the ordinary season, the grain ration seemed to have the greatest effect. In the last two weeks of the experiment, when more or less rain fell on every day but one and the weather was "raw," the percentage of fat in the milk of lot 1 decreased 9 per cent, while that of lot 2 decreased 20 per cent.

While the average analysis of the milk for three days was invariably above the required legal standard, yet there was one day when the milk for one lot fell below the legal requirements of 12 per cent total solids. This suggests that it is hardly fair to impose a heavy fine or imprisonment as the result of a single analysis of milk.

BULLETIN No. 11. DECEMBER, 1889.

ON THE STRAWBERRY LEAF BLIGHT (SPHÆRELLA FRAGARIÆ, SACC.). W. R. DUDLEY, M. S. (pp. 171–182), (illustrated).—A report on investigations of the life history of the fungus causing this disease, made by the author, with the assistance of Miss J. W. Snow. Suggestions as to remedies are also given, and the bulletin is illustrated with cuts from original drawings. The new points brought out are indicated in the following summary, taken from the bulletin:

1. *Sphærella fragariæ*, Saccardo, passes the winter in this region in at least three different conditions: (1) as mycelium in the leaves near the spots; (2) in the so-called sclerotia; (3) as ascospores in perithecia.

2. Reproduction is provided for through conidia and ascospores: The former ephemeral, the latter long-lived.

3. The ascospores germinate within the ascus and perithecium, and their mycelium, growing through the mouth of the perithecium, rapidly produces numerous conidia, capable of infecting the strawberry. There seems to be proof that no infections take place directly from the germinating ascospore.

4. The only mode now known of infecting the new leaves of the host plant is through the conidia, which grow from the mycelium about the white spots, from that of the sclerotia, and from that produced by the ascospore. Consequently the conidia, or the spotted leaves themselves, must be destroyed in order to insure immunity against disease.

5. The mycelium does not descend to the stem or roots through the leaf-stalks and pass the winter there. Therefore destruction of the leaves in the fall or spring destroys the fungus.

6. Aside from care in the selection of soil and in good cultivation two modes of treatment will be found to repay the fruit grower: First, if the season opens unfavorably, the regular use of the fungicides recommended (sulphide of potassium, 1 ounce to 8 gallons of water, or carbonate of copper dissolved in one quart of water and diluted to 20 gallons); second, if the fungus persists till autumn, destruction in the following spring of all old leaves by burning over.

ASCOCHYTA FRAGARLE, SACC., W. R. DUDLEY, M. S. (pp. 182, 183).—A brief account of some preliminary investigations of a disease of the strawberry thought to be due to this fungus.

BULLETIN No. 15, DECEMBER, 1889.

MISCELLANEOUS ANALYSES, 1889, W. P. CUTTER, B. S. (pp. 187, 188).—These include chemical analyses of ashes, cotton-seed-hull ashes, malt sprouts, cotton-seed hulls, "corn germ" (refuse from a starch factory), wheat bran (new process), "Condimental Cattle Food" (wheat bran or shorts mixed with a small quantity of salt and some aromatic plant), and soot.

STUDIES IN BOTANY, A. N. PRENTISS, M. S. (pp. 189–192).

(1) *Notes on meadow-grasses* (pp. 189, 190).—Brief notes on experiments with Kentucky blue-grass (*Poa pratensis*), wire-grass (*Poa compressa*), fowl meadow-grass (*Poa serotina*), rough meadow-grass (*Poa trivialis*), wood meadow-grass (*Poa nemoralis*), and water meadow-grass (*Poa aquatica*). "The notes indicate the great difficulty of obtaining a satisfactory seeding with commercial grass seed, especially as regards those kinds less generally in use."

(2) *On root propagation of Canada thistle* (pp. 190, 191).—A brief preliminary report of a pot experiment with cuttings from 1 to one-sixteenth inch in length. The results thus far obtained seem to indicate that while minute portions of the root are not likely to grow, pieces longer than one-fourth of an inch will grow freely.

(3) *On the vitality of weed seeds* (pp. 191, 192).—Of thirty-two varieties collected in 1879 and kept under conditions unfavorable to the preservation of vitality, ten germinated in 1889 when sown in boxes in a greenhouse where the conditions were probably not so favorable for germination as in an out-of-door seed bed.

Studies in cryptogamic botany, W. R. Dudley, M. S. (pp. 193–199).—These brief notes on subjects now under investigation at the Station were written chiefly to solicit information from those practically acquainted with the plant diseases referred to. The subjects treated are the onion mold (*Peronospora schleideniana*, De Bary); anthracnose of currants (*Glœosporium ribis*, [Lib.], Mont. and Desm.); and the leaf blight of quince and pear (*Entomosporium maculatum*, Lev.).

The apple-tree tent caterpillar (Clisiocampa americana), J. H. Comstock, B. S. (pp. 199–202).—A brief account of this insect and the methods used for its destruction.

Field trials with fertilizers, I. P. Roberts, M. Agr. (pp. 203, 204).—Experiments begun in 1879 have indicated that commercial fertilizers, especially phosphates, have not been of immediate service to plants on the soil of the Station farm. In 1888 in experiments in three different parts of the farm on silage corn, clover and timothy mixed, and oats, ground bone, cotton-seed meal and hull ashes, and "Star Bone Phosphate," singly and in combination, applied broadcast at the rate of 400 pounds per acre, gave average results slightly below those obtained without the use of fertilizers.

A point in the cultivation of root-crops, I. P. Roberts, M. Agr. (pp. 204, 205).—The author states that the result of his experience leads him to believe that roots should be planted early and given the least possible amount of hand cultivation if a profitable crop is to be secured. This is illustrated by the financial record of a crop raised in 1889.

Studies in horticulture, L. H. Bailey, M. S. (pp. 206–216).—Notes on the Orange melon and Crandall currant; on a small experiment showing the influence of soil upon peas; on an experiment on the influence of depth of transplanting upon the heading of cabbages, with negative results; on tests of seeds of tomatoes, cauliflowers, and beans, in which the results of sowing one-quarter inch and one-half inch deep were practically the same as regards the germination of the seeds; on tests of a large number of cucurbits, in which the age of seeds did not materially affect the length or productiveness of vines; and on tests of a "patent germinator," with unfavorable results.

NORTH CAROLINA.

North Carolina Agricultural Experiment Station.

Location, Raleigh. Director, H. B. Battle, Ph. D.

BULLETIN No. 64, JULY, 1889.

Practical stock feeding on scientific principles, F. B. Dancy, B. A. (pp. 3–19).—The object of this article is stated to be "to explain to the farmers of North Carolina, first, the principles underlying the science of stock feeding and stock foods, and, secondly, the application of these principles," so that with the aid of "feeding standards" and "digestion tables" they may be able to feed more intelligently and economically. The importance of the subject is illustrated by a reference to the United States census of 1880, which showed that there were in this State 2,788,162 farm animals. If, through ignorance or carelessness, these animals receive an excess of food materials amounting to only 10 cents per year per head, the aggregate annual waste would represent a value equal to $278,816.20. "It is plainly as much true economy to feed judiciously as to produce judiciously. The quantity and quality of the food administered should be measured by the end desired to be obtained."

The science and practice of stock feeding are discussed in this bulletin under three heads: (1) The chemistry of cattle foods, or what are the valuable ingredients of fodders, and, briefly, how they are determined; (2) the value of each of these ingredients in the economy of the animal; (3) the study of certain feeding and digestion tables founded on the first two, and how to use them in practical feeding.

Technical terms, such as albuminoids, crude fiber, nitrogen-free extract, co-efficients of digestion, and nutritive ratio, are explained. Tables of feeding standards and fodder analyses compiled from German and American sources are given and their use illustrated. In conclusion it is wisely urged that "the tables are only meant as guides by which to approximate truth. They can not be exact, for no two animals are alike. In their use the farmer must exercise judgment and common sense. Take the standards for a basis, combine them with good judgment and practical experience, and it can at least be promised that the farmer will be benefited by their use in excess of the benefit to be derived by relying on good judgment alone. If anyone should be disposed to doubt the practical side of feeding standards, and, by reason of a too common prejudice, to regard them as belonging to a large class of useless theoretical principles that are found on paper rather than in practice, let him remember that *these standards are the result of practice*."

BULLETIN No. 65, AUGUST-SEPTEMBER, 1889.

CO-OPERATIVE FIELD TESTS DURING 1888, H. B. BATTLE, PH. D. (pp. 23-64).—Under the direction of the Station twenty-one field experiments with fertilizers were undertaken in different parts of the State, the object in each case being "to ascertain the needs of the soil to grow a given crop." Two of the experiments were made with peanuts, two with potatoes, four with corn, and thirteen with cotton, in as many different counties. Careful farmers were selected to co-operate in the work, fertilizers and plans for the experimental plats being furnished by the Station. As far as possible the plats were one-tenth of an acre each in size and twenty-one in number in each series. Phosphoric acid, potash, and nitrogen were supplied with other ingredients in acid phosphate, kainit, and cotton-seed meal, respectively. The fertilizers were applied singly, each in two different quantities;

two by two, each mixture in two different quantities; and all three together, each mixture in four different quantities. Three plats were left unmanured, and two were treated with stable manure.

The experiments seem to have been vitiated to a greater or less extent by unfavorable climatic influences, one with potatoes and three with cotton being discontinued by reason, in part, of the disastrous season. Marked unevenness of the soil also seems to be indicated by the produce from the unmanured plats of a number of the experiments, and this fact will probably account in large measure for the wide variation of results obtained. These are presented in tabular form, and convenient summaries are given of the experiments with potatoes, corn, and cotton. Deductions from the results are intended to apply to the average soils embraced in these experiments. "Potatoes responded well to all fertilizers." With corn "all applications, with few insignificant exceptions, proved total losses."

Application of fertilizing material on cotton seems, with few exceptions, to have been profitable. Acid phosphate alone was for the most part unprofitable; cotton-seed meal alone profitable in the majority of cases, and kainit alone unprofitable in most cases, though apparently serving to some extent as a preventive of rust. Next to stable manure, the mixtures of all three materials were most efficacious. "The best proportion of these ingredients was 200 pounds of acid phosphate, 100 pounds of cotton-seed meal, and 50 pounds of kainit to the acre of average soil." On poor land "this application might well be increased." It is to be observed that this mixture is similar in composition to some of the commercial fertilizers most commonly used in the State. Of course, soils differ widely, and the fertilizers best adapted to each differ in like manner.

BULLETIN No. 66, SEPTEMBER 15, 1889.

STOCK FEEDING AS PRACTICED IN NORTH CAROLINA, F. B. DANCY, B. A. (pp. 68–80).—This is the second of a series of bulletins on cattle foods and cattle feeding. The Station sent out to farmers in all sections of the State blank forms to be filled out, "asking for information as to the amount of daily rations (in weights or measures) furnished horses, mules, oxen, sheep, milch cows, and hogs, for purposes of light, ordinary, or heavy work, or for purposes of fattening, milk and butter production, or wool production." It was hoped in this way to get light on the question whether the farmers were overfeeding or underfeeding. Only thirty-eight of the one hundred blanks sent were returned, and of these only twenty-seven contained information which could be used for purposes of comparison. A good many of the farmers to whom these blanks were sent had "never weighed or measured a ration." Several wrote letters merely stating their inability to furnish exact weights or measures, but giving some general observations based on their experience as to stock feeding.

The fullest returns were obtained for horses and mules; milch cows and oxen came next; for sheep and hogs the reports were so meager that no comparison of them was attempted. In general the returns showed that Indian corn is the chief feeding stuff used by the North Carolina farmer; that hay and corn stover are used interchangeably in equal amounts, and that oats, regarded as equal to corn, pound for pound, comes next to corn as the grain fodder.

In comparing and averaging the various rations reported the following plan was adopted: "The grain part of the ration is in each case brought to a corn basis, and the framework of the ration is in each case brought to a hay or corn fodder basis, the latter two being taken as equal. Oats are, for the reasons given, converted into corn, weight for weight." The highest, lowest, and average rations for horses, mules, oxen, and cows are given; the objectionable features of a ration made up of corn and corn stover, or corn and hay, are illustrated; and it is shown how cotton-seed meal might be advantageously used as a substitute for part of the other ingredients in the ration. Extracts from some of the letters received from farmers on their methods of stock feeding are also given.

The practical lesson of these investigations is the same as has been taught by researches in this line in other parts of our country, viz, that our farmers as a rule feed relatively too much corn and too little nitrogenous food.

INDIAN CORN, G. McCARTHY, B. S. (pp. 77–80).—This contains some general statements on the history, botany, and proper treatment of this plant.

BULLETIN No. 67, OCTOBER 15, 1889.

SEED TESTS, G. McCARTHY, B. S. (pp. 83–96).—Bulletin No. 59 (August–September, 1888) of this Station contained the results of examinations of seeds of field crops, mainly grasses, which showed an average vitality of only 56 per cent. In the present bulletin the results of tests of a large number of samples of garden seeds are given. "Most of the different kinds of seeds tested were found true to name and reasonably free from impurities. The low vitality shown by many of the samples was due to staleness of the seeds." When the seeds were fresh they had, as a rule, a high percentage of vitality. The tabular records given in the bulletin include for each sample the name of the seedsman; place of purchase; number of days before first and last sprout appeared; per cent of purity, vitality, and valuation; and number of seeds in one gram and one ounce.

BULLETIN No. 68, NOVEMBER 1, 1889.

FARM AND DAIRY BUILDINGS, J. R. CHAMBERLAIN, B. S. (pp. 99–104).—A description of the new barn, silos, and dairy-house of the Station, with illustrations and plans.

OHIO.

Ohio Agricultural Experiment Station.

Location, Columbus. Director, Charles E. Thorne.

BULLETIN VOL. II, NO. 4 (SECOND SERIES), JULY, 1889.

EXPERIMENTS WITH SMALL FRUITS IN 1889, W. J. GREEN (pp. 101–110).—The conditions on which new varieties are received for testing are stated.

Strawberries.—Tabular data on eighteen new varieties are given, with additional notes on some of these varieties and on a number of varieties previously reported. "The following varieties have been fully tested and can be recommended for general planting: Bubach, Haverland, Ohio, Pearl, Crescent, Warfield."

Raspberries.—Tabular data on eighteen varieties, with additional notes on ten of the same varieties. "The following of the newer varieties are recommended: Hilborn, Muskingum, Palmer."

Blackberries.—Tabular data on thirteen varieties, with additional notes on these and other varieties by an amateur fruit grower living near the Station. The number and weight of perfect and imperfect berries in one quart at three different pickings are also recorded for five varieties. The hardiest and most worthy of cultivation are Agawam, Ancient Briton, Bonanza, Early Harvest, Taylor, Snyder.

Gooseberries.—Brief notes on four varieties.

EFFECT OF EARLY AND LATE PICKING UPON THE KEEPING QUALITY OF APPLES, W. J. GREEN (pp. 111–114).—One hundred perfect apples of each of five varieties were selected at four different pickings, from September 26 to October 20, and stored in crates in an ordinary cellar. A record is given of the number in each one hundred which were sound, 58 days, 175 days, and 256 days from picking. The per cent of shrinkage by rot and waste 58 days from picking is also given. The conclusions drawn from these experiments are that "early picking of apples improves their keeping qualities, but no difference is manifest for nearly six months after picking. If kept for a longer period than six months, the early-picked apples show a decided gain over those picked late. The greater part of the loss in weight, caused by drying, occurs within six months after picking. The early-picked apples lose slightly more in weight than those that are picked late."

BULLETIN VOL. II, NO. 5 (SECOND SERIES), AUGUST, 1889.

EXPERIMENTS IN WHEAT SEEDING, J. F. HICKMAN, M. A. S. (pp. 115–120).—This article is not confined to the discussion of new work, but is, in the main, a report of progress, adding another to the series of tests begun seven years ago. The topics are: (1) Thick and thin seeding; (2) early and late seeding; (3) seeding at different depths and by different methods. Velvet Chaff (Penquite's) wheat was used in all the experiments reported.

Thick and thin seeding.—This experiment has been going on for eight years. The rates of seeding have been from 2 to 9 pecks per acre. In 1889 the 6-peck rate gave a slightly higher yield than any of the others, but was closely followed by the 5 and 9 peck rates. Duplicate tests implied that the soil used in this test was quite uniform, and the results varied very little, except that the yields from the 2 and 3 peck rates fell sufficiently below the others to indicate that these amounts of seed are too small to secure the best results. For the eight years the 7-peck rate gave the highest average yield, but is closely followed by the 5 and 6 peck rates.

Early and late seeding.—"Previous to the fall of 1888 it was the practice of the Station in this experiment to plow, harrow, roll, and drill the wheat for each seeding all the same day. In the fall of 1888 instead of preparing the ground and drilling the wheat the same day, we began a week ahead with the plowing." A table gives the dates of seeding from August 22 to November 1, yield per acre of grain and straw, and pounds of straw per 100 pounds of grain for nine plats used in 1889. Much better results were obtained that year from seeding after the middle of September than before that time. In another table the yields of grain per acre in similar experiments during six years are compared. During these six years the best yields of wheat were obtained on this farm when the seed was sown the last of September or the first of October.

Methods of culture and different depths of seeding.—A table gives the results attained by various methods of seeding, Lois Weedon culture, light and heavy mulching, and different depths of planting the seeds. The Lois Weedon culture consists of alternate wheat and fallow, one half the plat being in wheat while the other half lies fallow. The differences in yield from the different methods of culture are not sufficient to justify the claim of superiority for any one. Light mulching has not been of any advantage, while heavier mulching of from 2 to 3 inches proved destructive to the wheat on this land. "Thus far in our experiments the mulching of winter wheat (for winter protection) has not proven of any practical benefit." In this, as in previous experiments, a considerably larger yield of grain was obtained when the wheat was drilled 1½ and 3 inches deep than when it was drilled 4 inches deep. "The depth of drilling wheat must be governed by the soil. Lighter soils will permit the wheat to be put in deeper than soils that are heavy, or that are of such composition that they are likely to bake after rain."

Commercial fertilizers on wheat.—The experiments carried on by the Station with organic and inorganic manures since 1882 have been continued during the years 1888 and 1889. Between fifty and sixty experiments, made in 1888, have not been reported in the Station publications. Experiments with commercial and farm manures were made on about eighty plats, together with box experiments and co-operative field tests on representative soils in various parts of the

State. The details of these experiments are not yet ready for publication, but the following brief summary of the results thus far obtained is given:

(1) On sterile lands both nitrogen and phosphoric acid must be present in a fertilizer, the nitrogen in relatively large proportion, in order to produce any beneficial effect upon the crop.

(2) On soils of medium fertility nitrogen (in nitrate of soda) seems to produce a more marked effect than phosphoric acid, yet both seem to be essential.

(3) On soils capable of producing 30 to 40 bushels of wheat to the acre with good tillage alone, we have failed to gain any increase of crop by the use of any fertilizer or combination of fertilizers.

(4) Potash seems to be less often required than either nitrogen or phosphoric acid. We have thus far failed to gain any increase on any soil from the use of potash alone, but it has sometimes produced a slight increase when added to nitrogen and phosphoric acid.

COMPARATIVE TEST OF VARIETIES OF WHEAT, J. F. HICKMAN, M. A. S. (pp. 121–132).—"Previous to the fall of 1888 the 'south field' (about 16 acres) had been used for six successive seasons in variety and cultural tests of wheat. The plats used were of various sizes, most of them being one thirty-second acre in size, and were laid out so that they were drilled north and south. A diagram represents the field as replatted in the fall of 1888. Most of it was laid out in tenth-acre plats, running east and west. These plats are 16 feet wide by 272$\frac{1}{4}$ feet long, and are separated by spaces 2 feet wide. * * * On one section, however, nearly three hundred differently named sorts of wheat are grown in plats about 5 feet square. The results of this work will be discussed in a subsequent article."

The results of comparative tests of 96 varieties in 1889 are given in tabular form. Another table contains a compilation of results of tests of 67 varieties for nine years, showing the yield of each variety for each year that it has been grown at the Station, and also the average yield for the period during which it has been grown here. A third table gives the yearly and average yield of 17 varieties grown at the Station for five years.

Synonyms.—"Red Fultz and Poole bear a close resemblance to the old Michigan Amber. Royal Australian seems to be the old Clawson under a new name. Diehl-Mediterranean is also called Hybrid Mediterranean, and appears to be synonymous with Raub's Black Prolific, Missouri Blue Stem, Brady Lake, Seneca Chief, Michigan Bronze, Andrews' No. 4, Sibley's Hybrid, and Golden Cross. Silver Chaff, Martin's Amber, and Landreth are probably one variety. Tasmanian Red bears a close resemblance to Mediterranean, and Finley and Rice seem to be scarcely variations of Fultz."

Bearded vs. smooth, and red vs. white wheats.—"In averaging the yields for 1889 we find that thirty-one varieties of bearded wheat give an average of 40$\frac{1}{2}$ bushels per acre, while the thirty-six smooth wheats yield an average of 37.4 bushels per acre. Six white wheats average about 37 bushels, while the red wheats average a little over 38 bushels."

"It has been the custom of this Station in past years to distribute seed wheat in small quantities, gratuitously, to farmers in different parts of the State, in return for which the Station required reports giving description of soil, previous treatment, and results at harvest." From lack of definiteness of conditions of treatment and of personal supervision by trained experimenters, the reports have been unsatisfactory, and the Station, therefore, has discontinued the gratuitous distribution of seed wheat, but will sell its surplus wheat to farmers of the State at moderate rates.

BULLETIN VOL. II, NO. 6 (SECOND SERIES), SEPTEMBER, 1889.

REMEDIES FOR THE PLUM CURCULIO (CONOTRACHELUS NENUPHAR), C. M. WEED, M. S. (pp. 133–143).—A report on the continuation of experiments begun in 1888, as recorded in the Report of the Ohio Station for 1888, pp. 134–150. Details are given and illustrated by diagrams. The following conclusions, provisionally announced over a year ago,* are confirmed as the result of two seasons' work on two varieties of cherry-trees and four varieties of plum-trees, during which time 65,500 cherries have been individually examined:

(1) About three-fourths of the cherries liable to injury by the plum curculio can be saved by two or three applications of London purple in the proportion of 1 ounce to 10 gallons of water.

(2) A sufficiently large proportion of the plum crop can be saved by the same treatment to insure a good yield when a fair amount of fruit is set.

(3) If an interval of a month or more occurs between the last application and the ripening of the fruit, no danger to health need be apprehended from its use.

(4) Spraying with the arsenites is cheaper and more practical than any other method of preventing the injuries of this insect.

REMEDIES FOR THE STRIPED CUCUMBER BEETLE (DIABROTICA VITTATA), C. M. WEED, M. S. (pp. 143–148).—The following summary is taken from the bulletin:

"The present article embodies the results of the season's work on a series of experiments undertaken to determine the preventive or remedial value of the following methods recommended to prevent the injuries of the striped cucumber beetle: (1) the use of offensive odors; (2) mechanical coatings of the leaves; (3) poisonous coatings of the leaves; (4) inclosing plants under tents or gauze frames.

"The experiments were made on a large scale under ordinary field conditions during the summer of 1889, when the striped beetles were exceedingly abundant.

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* Ohio Station Bulletin No. 4, p. 32.

"Five substances of the first class were tested, viz, hen manure, cow manure, kerosene, carbolic acid, and bisulphide of carbon. None of these proved practically successful.

"Three substances of the second class were tested, viz, coal soot, gypsum, and saltpeter. Of these coal soot and saltpeter proved worthless, while gypsum showed one beneficial effect, not sufficient, however, to save the plants wholly.

"Three substances of the third class were applied, viz, pyrethrum, slug shot, and 'peroxide of silicates.' Pyrethrum killed those beetles with which it came in contact when first applied, but soon lost its efficacy. Slug shot injured the plants to which it was applied. Peroxide of silicates has a decided effect in preventing injury, and where the plants had been well started before being attacked saved them from destruction. But it did not save them where beetles were so numerous that they burrowed down to the sprouting plants.

"The results obtained from the fourth method, that of fencing out the insects by covering the plants with some form of tent or gauze-covered frame, were by far the most satisfactory. The cheapest and most successful method employed is that of protecting each hill by a piece of plant cloth or cheese cloth about 2 feet square. This may be done by simply placing it over the plants and fastening the edges down by small stones or loose earth. It is better, however, to hold it up by means of a half barrel hoop or a wire bent in the form of a croquet arch."

THIRD CONTRIBUTION TO A KNOWLEDGE OF THE LIFE HISTORY OF CERTAIN LITTLE-KNOWN PLANT LICE, C. M. WEED, M. S. (pp. 148–152).—Notes on the strawberry root louse (*Aphis forbesi*, N. S.), and the grain plant louse (*Siphonophora avenæ*).

NOTES ON SOME LITTLE-KNOWN, INJURIOUS INSECTS, C. M. WEED, M. S. (pp. 153–156), (illustrated).—The insects included in this report are a snout beetle (*Lixus concavus*, Say), the imported currant worm (*Nematus ventricosus*), the green apple-leaf hopper (*Typlocyba albopicta*), the rose-leaf hopper (*Typlocyba rosæ*), and the cherry-tree slug (*Selandria cerasi*).

AN EXPERIMENT IN PREVENTING THE INJURIES OF THE POTATO ROT (PHYTOPHTHORA INFESTANS), C. M. WEED, M. S. (pp. 157–169).—Details are given and the results are summarized and illustrated by diagrams.

"(1) The experiment was undertaken to determine what effect the application of a solution of sulphate of copper and lime (known as the Bordeaux mixture) to the foliage of potatoes would have in preventing the injuries of the potato rot, and was conducted at the Station.

"(2) Fifteen feet at the end of each twenty rows of potatoes were sprayed with the Bordeaux mixture four times, viz, May 28, June 6, June 29, and July 16. Four varieties were included in the experiment, viz, Early Ohio, Early Oxford, Puritan, and Lee's Favorite.

"(3) The season proved favorable for the development of the blight, which appeared in the experimental field about the middle of June and did serious damage for the next six weeks.

"(4) The sprayed vines showed much less injury than their unsprayed companions, remaining green after the others were dead.

"(5) The crop was harvested August 22, and the product of 12½ feet of the sprayed part of each row was compared with the product of an equal distance of the unsprayed portion of the same row."

"So far as a single experiment can be relied upon, the results seem to indicate the correctness of the following provisional conclusions:

"(1) That a large proportion of the injury done by the potato rot can be prevented by spraying the vines with the Bordeaux mixture.

"(2) That this treatment apparently diminishes the amount of scab affecting the tubers.

"(3) That by adding London purple to the mixture the same treatment may be made effective in preventing the injuries of both the rot and the Colorado potato beetle."

BULLETIN VOL. I, NO. 1 (TECHNICAL SERIES *), OCTOBER, 1889.

ON THE PREPARATORY STAGES OF THE 20-SPOTTED LADY-BIRD (PSYLLOBORA 20-MACULATA, SAY), C. M. WEED, M. S. (pp. 3, 4), (illustrated).—Descriptions and figures of the larva and pupa of this insect, with observations made by the author in the fall of 1889.

STUDIES IN POND LIFE, C. M. WEED, M. S. (pp. 4–17), (illustrated).—The results of observations are given under the following heads: (1) On the life history of the large typha-borer (*Arzama obliquata*, G. and R.). (2) On the life history of the toothed-horned fish fly (*Chauliodes rastricornis*, Ramb.). (3) On the life history of the sagittaria curculio (*Listronotus latiusculus*, Boh.). (4) On the feeding habits of the lesser water-bug (*Zaitha fluminea*, Say). (5) On the feeding habits of the undulating back swimmer (*Notonecta undulata*, Say). (6) An aquatic leaf beetle (*Donacia subtilis*, Kunze). (7) An aquatic lady-bird (*Hippodamia 13-punctata*, DeG.). (8) On the eggs of the giant water-bugs (*Belostoma americanum*, Leidy, and *Benacus griseus*, Say).

A PARTIAL BIBLIOGRAPHY OF INSECTS AFFECTING CLOVER, C. M. WEED, M. S. (pp. 17–45).—In view of the injury inflicted on the clover crop in Ohio by the midge, clover-root borer, and other insects, the entomologist of this Station has begun an extended investigation of the insects affecting this plant, and as a basis for future work has prepared the partial bibliography published in this bulletin. A list of 82 species of insects known to attack clover is also given.

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* "This series of the bulletins of the Ohio Agricultural Experiment Station is intended to embody the technical results of the work of the Station. It is not expected that these results will be of direct service to farmers in general, but it is hoped that they may be found useful by workers in other Stations, and thus indirectly serve the cause of agriculture."

BULLETIN VOL. II, NO. 7 (SECOND SERIES), NOVEMBER, 1889.

EARLY CABBAGE—COMPARISON OF VARIETIES, W. J. GREEN (pp. 173–183).—"The test of early varieties of cabbage was conducted for the purpose of determining synonyms and of learning the relative value of old and new sorts. The particular object in view was to compare Early Wakefield with Etampes and Express. Former trials had shown that there was little, if any, difference in earliness between Early Wakefield and Etampes, while the former produced nearly 50 per cent more marketable heads than the latter. The Express made but little better showing than the Etampes."

The results of tests of comparative earliness of these varieties in 1888 and 1889 are given in tabular form and compared with results obtained at the New York State Station. Their relative marketable value was also reported. Brief notes on twenty-three varieties of cabbage are given and the comparative earliness and weight of heads are stated in a table for seventeen varieties.

Summary.—The Early Wakefield yields a greater per cent of its crop at a given early date than either Etampes or Express, and matures its entire crop earlier than either of the others.

In market value the Early Wakefield has exceeded the Etampes and Express by about 100 per cent, the entire crop of the former being marketable, while about one half the crop of the latter two varieties is soft and unsalable.

Etampes and Express are recent European importations, and are unable to endure the heat of our summers.

Buist's Earliest, Extra Early Advance, Everitt's Earliest, Faust's Earliest of All, Johnson & Stokes' Earliest, Landreth's Earliest, Premier, Rawson's Volunteer, and Salzer's Earliest are closely allied to Etampes, and appear to be selected strains of it, or that variety renamed. All are decidedly inferior to the Early Wakefield in this latitude.

The varieties most highly recommended for general cultivation are: All Seasons, Chase's Excelsior, Deep Head, Early Wakefield, Early Summer, Fottler, Henderson's Succession, Louisville Drum Head, Low's Peerless, and Winningstadt.

CAULIFLOWER—COMPARISON OF VARIETIES, W. J. GREEN (pp. 183–185).—"Tests have been made during two seasons of nearly all varieties of cauliflower offered by the leading seedsmen. The results indicate that but few varieties are suitable for growing in this latitude and that many of the so-called varieties are synonymous."

Brief notes on fifteen varieties are given. "The early varieties have usually given better results than the late, whether planted in early spring or midsummer. Better results have uniformly been obtained from late than from early planting.

"The varieties, or strains, most highly recommended are Early Puritan, Early Padilla, Long Island Beauty, Early Sea-Foam, Early Snowball, and Vick's Ideal. These all appear to be nearly identical with Early Erfurt, and may be considered as strains of that variety."

The varieties seeming to be unsuited to this climate are Lenormand, Veitch's Autumn Giant, Early Paris, Eclipse, and Algiers.

"Many strains of the Snowball have been sent out that are very inferior to that disseminated by Peter Henderson & Co."

PUGET SOUND CABBAGE AND CAULIFLOWER SEED, W. J. GREEN (p. 185).—The author states that the Puget Sound seeds have a high germinative power and that the plants grown from them are at first much more vigorous than those grown from Eastern seed, but this difference diminishes as the season advances, and the crops are substantially the same in time of maturing, quality, and quantity. The superior vitality and vigor of the plants from Puget Sound seeds enable them to better resist insect enemies and diseases, and if sufficient care is exercised in growing stock from these seeds they may, perhaps, "become recognized as the best in the market."

NOTES ON EXPERIMENTS WITH REMEDIES FOR CERTAIN PLANT DISEASES, C. M. WEED, M. S. (pp. 186–189), (illustrated).—The importance of combining insectides and fungicides is explained, and claim is made that this practice originated at this Station. Successful experiments with the Bordeaux mixture for black rot of grapes and quince-leaf spot are reported, as well as a partially successful experiment with London purple and the Bordeaux mixture on the brown rot of stone fruits, and an unsuccessful experiment with the Bordeaux mixture for apple scab.

BULLETIN VOL. II, NO. 8 (SECOND SERIES), DECEMBER, 1889.

EIGHTH ANNUAL REPORT FOR 1889 (pp. 7–54).—This includes the reports of the board of control, bursar, director, agriculturist, horticulturist, entomologist and botanist, veterinarian and bacteriologist, and meteorologist, and "the insect record for 1889." The reports consist for the most part of brief outlines and condensed summaries of the work of the year. A table of contents for the bulletins of 1889 is given in an appendix, and brief synopses of them are contained in the director's report. There is also an index to the publications of the year. This report will receive more complete notice in the Digest of Annual Reports of the Stations for 1889.

OREGON.

Oregon Experiment Station.

Department of Oregon State Agricultural College.

Location, Corvallis. Director, E. Grimm, B. S.

BULLETIN NO. 3, OCTOBER, 1889.

PRACTICAL WORK WITH INSECTICIDES, E. R. LAKE, M. S. (pp. 3–6).—A brief account of the treatment of "fifteen apple trees and three pear trees with London purple for the codling moth, twenty apple trees with kerosene emulsion for the woolly aphis, and several greenhouse plants with the same emulsion and tobacco water for the green aphis." The woolly aphis (*Schizoneura lanigera*) was treated with a hot kerosene emulsion prepared in the following proportions: kerosene 1 pint, whale-oil soap one-fourth pound, water 2 quarts. The water and soap were heated together and then the oil was added. The mixture was thoroughly churned with a force pump and diluted with 5 gallons of hot water before application. The results not being entirely satisfactory, lye water (1 pound of concentrated lye to 3 gallons of water) was used with entire success.

CORN WORM (HELIOTHIS ARMIGERA), F. L. WASHBURN, B. A. (pp. 7–9).—An illustrated account of this insect, with suggestions as to remedies.

INSECTICIDES AND SPRAYING MACHINES, F. L. WASHBURN, B. A. (pp. 10–24), (illustrated).—This contains explanations of a number of insecticides and general directions for their use, together with descriptions of various kinds of spraying apparatus.

PLANTS POISONOUS TO STOCK, P. H. IRISH, PH. D. (pp. 25, 26).—A brief preliminary account of an experiment in feeding two steers with plants popularly supposed to be poisonous.

PENNSYLVANIA.

The Pennsylvania State College Agricultural Experiment Station.

Department of the Pennsylvania State College.

Location, State College, Centre County. Director, H. P. Armsby, Ph. D.

BULLETIN No. 8, JULY, 1889.

SYSTEMATIC TESTING OF NEW VARIETIES—GERMINATION TESTS, G. C. BUTZ, M. S. (pp. 3–7).—The conditions on which tests of new varieties will be made by the Station are stated, being those agreed upon by the station horticulturists in convention at Columbus, Ohio, June, 1889. A list of the varieties of small fruits growing at the Station is given.

"Germination tests have been made this year with vegetable seed from the same packages as those used last year, in order to find to what extent they have deteriorated by being held over one year. There is too great a decrease in the percentage of good seed in the case of lettuce and tomatoes, for these seeds, if pure, should show about the same germinative power for about five years at least."

Germination tests of varieties of corn, oats, barley, forage plants, mangel-wurzels, ruta-bagas, and beets are also reported. Tests of a number of varieties of corn in the field compared with those in the laboratory showed that while the per cent of seeds which germinated in the field was quite uniformly smaller, the variations between different varieties were much the same as those shown by the germinating apparatus.

BULLETIN No. 9, OCTOBER, 1889.

DIGESTIBILITY OF CORN FODDER AND SILAGE, H. P. ARMSBY, PH. D., AND WM. H. CALDWELL, B. S. (pp. 3–16).—"The question of the relative value of dried corn fodder and of corn silage has been much discussed and has not yet reached its final solution. One important element in determining the relative value of these two fodders is their percentage digestibility, that is to say, the proportion of the several ingredients of each one which the animal is able to dissolve in its stomach and intestines and thus to utilize. The experiments reported in this bulletin are a contribution to this branch of the question."

Dent corn from a single field was used. Two portions were put into a silo divided into two pits. One pit was filled in one day; the other during seven days. A third portion was field-cured and stored in a barn.

In the digestion experiments two steers were used. These experiments were made in the usual way, by analyzing the entire food and the indigestible portion (solid excrement), and reckoning the difference as the digested portion. The results as given in detail in the bulletin may be briefly summarized as follows:

"(1) The field-cured fodder proved more digestible than the silage.

"(2) The difference was greatest in case of the woody fiber and but slight for the other ingredients.

"(3) The results of experiments elsewhere are conflicting, and further investigation is necessary."

RHODE ISLAND.

Rhode Island State Agricultural Experiment Station.

Department of Rhode Island State Agricultural School.

Location, Kingston. Director, Charles O. Flagg, B. S.

BULLETIN No. 3, SEPTEMBER, 1889.

STOCK FEEDING, H. J. WHEELER, PH. D. (pp. 31–67).—This is a brief treatise on the composition of animals and animal products; the constituents of plants, and their digestibility and functions in the animal economy; feeding standards, and their uses; and the general principles involved in the rational feeding of animals. The bulletin contains a number of tables of feeding standards, composition of American feeding stuffs, digestion co-efficients, percentages of digestible materials in feeding stuffs, and the fertilizing values of feeding stuffs, compiled from German and American sources.

BULLETIN No. 4, DECEMBER, 1889.

BEE KEEPING, S. CUSHMAN (pp. 71–90).—Statistics of this industry are quoted from the crop and other reports of this Department and from the Rhode Island census of 1885. Improvements in hives, varieties of bees, and management of apiaries are described. The value of bees not only as honey and wax producers, but also as agents in the cross-fertilization of plants is urged, with quotations of the opinions of many authorities on this subject. The wide-spread belief that bees injure fruit is combated with citations from reports of the Division of Entomology of this Department, the published opinions of Professors Packard and Gray, and the testimony of practical agriculturists in Rhode Island. Attention is called to the decision of the supreme court of Arkansas (June, 1889), that it is unconstitutional to prohibit bee keeping, and to a recent German law (October 1, 1889) protecting this business.

REPORT OF THE APIARIST, S. CUSHMAN (pp. 91–97).—An account of the work in apiculture done at this Station since the appointment of the apiarist, March 10, 1889. A yard of ten colonies has been established and made as nearly as possible a model working apiary. The desired varieties of bees have been procured, a daily record taken of the weight of a hive, a show of bees in glass hives made at the County Fair, and a collection commenced of the different kinds of hives, fixtures, etc., used by prominent American producers, and designed as a permanent exhibit at the Station. Sixteen colonies were prepared for winter, three placed in the cellar and the rest left on their summer stands surrounded by a water-tight outer case.

Donations of hives and other articles are acknowledged, and samples of different kinds of honey from different parts of the country as well as all articles of interest to bee keepers are solicited.

BULLETIN No. 5, DECEMBER 31, 1889.

POTATOES—METHODS OF PLANTING AND TEST OF VARIETIES, L. F. KINNEY, B. S. (pp. 101–107).—This is the first report of a series of experiments begun in 1889 to get light on the following questions:

(1) Is the yield of a hill of potatoes mainly determined by the space allotted to it in the row and the condition of the soil, or is it materially influenced by the amount of seed potatoes planted?

(2) Is the size of potatoes influenced by the quantity of seed planted?

(3) What varieties are best adapted to our soil and climate?

(4) Are northern potatoes better for seed than homegrown?

(5) What varieties are least subject to the potato rot?

The field used for the experiment was new land; the soil, loam with a yellow loam subsoil; and the natural drainage good. One hundred and fourteen rows, 104 feet long and 3 feet apart, were planted, each row with a different variety, except that eight rows contained duplicates of as many varieties from seed grown in Wisconsin. "Three pounds of seed potatoes were planted in each row, being divided equally in the three sections, thus allowing 1 pound to each 33⅓ feet, or section of a row. In the first section the pound of seed was cut into single-eye pieces and planted in forty-four hills, each 9 inches apart." In the second, the seed was cut into two-eye pieces and planted in twenty-two hills, each 18 inches apart. In the third, the potatoes were planted whole in eleven hills, or only cut sufficiently to fill out the section, with the hills 36 inches apart. All of the varieties sprouted evenly, but owing to the heat and moisture of the season all growth of vines ceased before August 1. The results for each variety are given in a table which shows the yield of both the merchantable and small potatoes for each of the three systems of planting, the average total yield, and the percentage of the total number of tubers affected by the potato rot. This season two-eye pieces planted 18 inches apart gave the best results. The average yield of the entire list of varieties was 54.19 bushels per acre.

METEOROLOGICAL SUMMARY (pp. 107, 108).—A record of observations from April 1 to December 31, 1889, inclusive.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

PART III.

DIVISION OF STATISTICS.

MISCELLANEOUS REPORT No. 1 (NEW SERIES).

REPORT ON FLAX, HEMP, RAMIE, AND JUTE. C. R. DODGE (pp. 104), (illustrated).—This embodies the results of investigations by the author as a special agent of this Department in 1889, in France, Belgium, and Ireland. The report is arranged in two parts, the first relating to flax and hemp culture in Europe, with descriptions of the latest inventions in flax-cleaning machinery, an account of the official trials of ramie decorticating machines at the Paris Exposition, and descriptions of the machines which competed. In reviewing the methods of work pursued in foreign countries, the author has taken into account particularly the wants and conditions of the fiber industry in the United States.

The second part is devoted to flax, hemp, ramie, and jute in the United States. The fact that 1,000,000 acres are planted in flax in this country annually, the straw of which is wasted or burned after the seed has been removed, while we are importing millions of dollars worth of fibers every year, emphasizes the importance of the present investigation, some of the results of which are detailed in this report. It is shown that by better methods of culture, and by a little more careful handling of the product, we may grow flax both for seed and fiber, and that there is a demand for the quality of fiber which can be produced here.

The cultivation of hemp in States north and south of the Ohio River is treated in full, with accounts of recent inventions in hemp-cleaning machinery. Hemp culture is being extended, and the product utilized in the manufacture of binder twine, which is shown to be equal to binder twine from Sisal and Manila, and several cents cheaper per pound. If our farmers would cultivate flax and hemp in sufficient quantities, it is estimated that, out of a total importation of raw fibers and manufactured products amounting to $44,000,000 annually, $26,000,000 might be saved to this country.

The present status of the ramie industry is also summed up, with full consideration of past discouragements, present obstacles, and future possibilities of the success of the industry in all its phases.

The fact that an Eastern manufacturing firm has created a demand for American ramie is encouraging. A perfectly satisfactory and economical decorticator is only needed to put the industry on its feet. The report closes with a short chapter on jute.

DIVISION OF CHEMISTRY.

BULLETIN No. 26.

RECORD OF EXPERIMENTS IN THE PRODUCTION OF SUGAR FROM SORGHUM IN 1889, H. W. WILEY (pp. 112).—The experiments on sorghum conducted by this Division during 1889 were divided into two classes: (1) Culture experiments to improve the sugar-producing qualities of the cane. (2) Chemical control of the manufacture of sugar from the cane.

These were carried on, separately or together, at Cedar Falls, Iowa; Rio Grande, N. J.; Morrisville, Va.; Kenner, La.; College Station, Md.; and Conway Springs, Attica, Medicine Lodge, Ness City, Liberal, Arkalon, Meade, Minneola, and Sterling, Kans. The experience of two seasons has shown that manufacturing and culture experiments should be carried on separately to insure the best results. The report includes a summary of the work of the season of 1889 and of the conclusions therefrom, by the chief of the Division; the report of the special agent, W. W. Cook, who visited various factories and cane growers in Kansas and collated information regarding the cost of buildings and plant, amount paid for cane, amount of sugar and sirup manufactured, and other details; and abstracts from the reports of officers having the work in charge at the various places where experiments were made. The results of manufacturing were, in general, unsuccessful. Among the causes of failure were the poor quality of the cane, lack of water, certain difficulties inseparable from the use of the new buildings and machinery, and the inexperience of the employés. It also does not seem as yet to be understood that only with large capital and the most approved machinery and methods is there any reasonable hope of financial success in making sugar from sorghum cane.

Among the conclusions reached from the culture experiments are the following:

(1) When the proper amount of moisture is furnished, the sugar content will depend on the total quantity of sunlight received by the plant.

(2) Sorghum as a sugar-producing crop can be grown successfully in this country only south of the mean isotherm of 70° F. for the summer months and where the moisture is not excessive. The most

favorable conditions are found in the semi-arid region of the southwestern central portion of the United States.

(3) The cause of a poor yield of sugar in sorghum of high polarization is due to the presence of some form of carbohydrates or other organic body, exercising a higher melassigenic power than invert sugar or any form of levulose and dextrose.

(4) The tendency of selected seeds from rich canes to produce a uniform crop of high polarizing canes under favorable conditions of light and heat is established.

(5) The possibility of developing, from existing varieties, a permanently improved crop, capable of cultivation for manufacturing purposes, is fully assured.

(6) The prospects of doing this with two or three of the standard varieties is more promising than dependence on an experimental or fortuitous development of a new variety free from the faults inherent in sorghum.

In brief, the conditions of success in sorghum growing for sugar are (1) a climate thoroughly adapted to the plant; (2) scientifically tested seed of the most approved varieties; (3) much more careful cultivation than is usually bestowed on corn.

DIVISION OF ENTOMOLOGY.

BULLETIN No. 21.

NATURAL ENEMIES OF THE FLUTED SCALE IN AUSTRALIA, A. KOEBELE (pp. 32), (illustrated).—A report of investigations on the natural enemies of the fluted scale (*Icerya purchasi*, Maskell), made in Australia during 1888–89, under the authority of the United States Commissioner of Agriculture. As the result of these investigations a number of species of insects which prey upon the fluted scale have been introduced into California, and one of these species seems already quite at home there. In the introduction to this report Professor Riley writes as follows regarding this insect:

> One of the insects imported, viz, the Cardinal Vedalia (*Vedalia cardinalis*, Mulsant), has multiplied and increased to such an extent as to rid many of the orange groves from Icerya and to promise immunity in the near future for the entire State of California. In fact, the rapid multiplication and the effective work of this little beetle are almost incomprehensible until we come to consider its power of increase in a climate like that of Southern California, where there is scarcely any cessation in its activities. [For details regarding the Vedalia, see Insect Life, Vol. II, No. 3, pp. 70–74.] The period from the laying of the eggs until the adults again appear occupies less than thirty days for the Vedalia. At this rate of increase, calculating that three hundred eggs are laid by each female, and that one-half of these produce females, it will readily be seen that in six months the offspring of a single female beetle may, under favorable circumstances, amount to over twenty-two trillions. So far it has not been noticed to prey upon any other insect than the fluted scale, a fact which accounts somewhat for its exceptionally rapid work, and renders the outlook extremely encouraging.

By reason of the extraordinary increase and spread of the Vedalia and the consequent rapid destruction of the scale, it is feared that none of the other enemies of the scale will become established in California. This is to be regretted, especially as regards *Cryptochætum iceryæ*, which would have been very valuable in localities which might be forsaken at any time by the Vedalia.

SILK SECTION.

BULLETIN No. 1.

How to raise silkworms, Philip Walker (pp. 16), (illustrated).—This is a brief manual of instructions for persons intending to experiment in raising silkworms, abridged from Bulletin No. 9, of the Division of Entomology. It includes an account of the silkworm and its food, the implements necessary for silk raising, and the proper methods of wintering and hatching the eggs, rearing the worms, and preparing the cocoons for market.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

MARCH 1 TO MAY 1, 1890.

DIVISION OF STATISTICS:

Report No. 71 (new series), March, 1890.—Distribution and Consumption of Corn and Wheat.

Report No. 72 (new series), April, 1890.—Condition of Winter Grain and of Farm Animals.

Miscellaneous Report (new series), No. 1.—Flax, Hemp, Ramie, and Jute.

DIVISION OF CHEMISTRY:

Bulletin No. 24.—Proceedings of the Sixth Annual Convention of the Association of Official Agricultural Chemists.

Bulletin No. 26.—Record of Experiments in the Production of Sugar from Sorghum in 1889.

DIVISION OF ENTOMOLOGY:

Periodical Bulletin Vol. II, No. 9, March, 1890.—Insect Life.

SILK SECTION:

Bulletin No. 1.—How to Raise Silk-Worms.

BUREAU OF ANIMAL INDUSTRY:

Special Bulletin.—Inoculation as a Preventive of Swine Diseases.

Special Bulletin.—Beef Supply of the United States and Export Trade in Animals and Meat Products.

Fourth and Fifth Annual Reports, 1887 and 1888.

DIVISION OF FORESTRY:

Circular No. 5.—Arbor Day Planting in Eastern States.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

MARCH 1 TO MAY 1, 1890.

ALABAMA.

Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama:
- Bulletin No. 11 (new series), February, 1890.—Peaches and plums.
- Bulletin No. 12 (new series), February, 1890.—Co-operative Soil Tests.
- Bulletin No. 13 (new series). March, 1890.—Microscopic Study of Certain Varieties of Cotton.
- Second Annual Report, 1889.

Canebrake Agricultural Experiment Station:
- Bulletin No. 6, October, 1889.—Vegetables; Grapes; Meteorology; Soil Temperatures.
- Bulletin No. 7, February, 1890.—Cotton; Corn; Peas; Melilotus.
- Annual Report for 1889.

ARKANSAS.

Arkansas Agricultural Experiment Station:
- Second Annual Report, 1889.

COLORADO.

Agricultural Experiment Station of Colorado:
- Bulletin No. 10, January, 1890.—Tobacco.
- Bulletin No. 11, April, 1890.—Sugar-Beets.
- Second Annual Report, 1889.

CONNECTICUT.

The Connecticut Agricultural Experiment Station:
- Bulletin No. 102, March, 1890.—Fungicides.
- Annual Report for 1889.

DELAWARE.

The Delaware College Agricultural Experiment Station:
- Bulletin No. 7, December, 1889.—Stock Feeding.
- Bulletin No. 8, March, 1890.—Possibilities of a Domestic Sugar Industry; Sulphide of Potassium for Pear Scab; London Purple for the Codling Moth.
- Second Annual Report. 1889.

ILLINOIS.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS:

Bulletin No. 7, November, 1889.—The Biology of Silage; Field Experiments with Oats, 1889.

Bulletin No. 8, February, 1890.—Field Experiments with Corn, 1889; Garden Experiments with Sweet-Corn, 1889.

INDIANA.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Meteorological Bulletin, February, 1890.

Bulletin No. 30, February, 1890.—Influenza in Horses.

Bulletin No. 31, April, 1890.—Small Fruits and Vegetables.

IOWA.

IOWA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 8, February, 1890.—Iowa Station Milk Test; Sweet Cream Butter; Sugar-Beets; Sorghum; Annual Report.

KENTUCKY.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 22, December, 1889.—Potato Experiments.

Bulletin No. 23, February, 1890.—Experiments with Oats; Fertilizers on Meadow Land.

Bulletin No. 24, March, 1890.—The Broom-Rape of Hemp and Tobacco.

Bulletin No. 25, April, 1890.—Strawberries.

LOUISIANA.

STATE EXPERIMENT STATION:

Second Annual Report, 1889.

NORTH LOUISIANA EXPERIMENT STATION:

Bulletin No. 27.—Report of the North Louisiana Experiment Station for 1889.

MARYLAND.

MARYLAND AGRICULTURAL EXPERIMENT STATION:

Second Annual Report, 1889.

MASSACHUSETTS.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 36, March, 1890.—Improvement of Farm Lands; Analyses of Fodder Articles; Commercial Fertilizers.

Seventh Annual Report, 1889.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletins Nos. 14 and 15, February and March, 1890.

Bulletin No. 8, April, 1890.—Experiments in Greenhouse Heating; Some Observations on Peach Yellows; How far may a Cow be Tuberculous before her Milk becomes Dangerous as an Article of Food?

MICHIGAN.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:

Bulletin No. 57, March, 1890.—Vegetables, Tests of Varieties and Methods of Culture.

Bulletin No. 58, March, 1890.—Insecticides.

Second Annual Report for the Year ending June 30, 1889.

MISSISSIPPI.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 11, February 15, 1890.—Charbon.

Second Annual Report, 1889.

MISSOURI.

MISSOURI AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 10, April, 1890.—Analyses of Apples at various Stages of Growth; Bordeaux Mixture for Grape Rot; Comparative Tests of Small Fruits and Potatoes.

NEBRASKA.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:

Bulletin No. 12.—Field Experiments for 1889.

Bulletin No. 13.—Experiments in the Culture of the Sugar-Beet in Nebraska.

Third Annual Report, 1889.

NEVADA.

NEVADA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 7, December. 1889.—Meteorological Report for October, November, and December, 1889.

NEW HAMPSHIRE.

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 9, February, 1890.—Effect of Food upon Milk.

Bulletin No. 10, March, 1890.—Co-operative Fertilizer Experiments.

NEW JERSEY.

NEW JERSEY AGRICULTURAL COLLEGE EXPERIMENT STATION:

Bulletin No. 64, December, 31, 1889.—Some Fungus Diseases of the Cranberry.

NEW YORK.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 18 (new series), November, 1889.—Testing of Dairy Breeds.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 14, December, 1889.—The Strawberry Leaf Blight and another Disease of the Strawberry.

Bulletin No. 15, December, 1889.—Sundry Investigations made during the Year.

Second Annual Report, 1889.

NORTH CAROLINA.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 69, February 26, 1890.—Fertilizer Analyses.

OHIO.

OHIO AGRICULTURAL EXPERIMENT STATION:

Bulletin Vol. II, No. 8 (second series), December, 1889.—Eighth Annual Report, 1889.

Bulletin Vol. III, No. 1 (second series), January, 1890.—Experiments with Potatoes.

Bulletin Vol. III, No. 2 (second series), February, 1890.—Commercial Fertilizers.

PENNSYLVANIA.

THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 10, January, 1890.—Should Farmers raise their own Vegetable Seeds? Notes on Varieties of Vegetables and Field Crops.

RHODE ISLAND.

RHODE ISLAND STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 2, June, 1889.—Description of the Station Farm.

Bulletin No. 3, September, 1889.—Stock Feeding.

Bulletin No. 5, December 31, 1889.—Potatoes; Methods of Planting and Test of Varieties.

SOUTH DAKOTA.

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 16, February, 1890.—The Sugar-Beet.

VIRGINIA.

VIRGINIA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 3, November, 1889.—Steer Feeding; Meteorological Record.

Bulletin No. 4, January, 1890.—Tomatoes; Field Tests and Chemical Composition.

WEST VIRGINIA.

WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 5, June, 1889.—The Selection of Milch Cows.

Bulletin No. 6.—Six Months' Experience in Running a Creamery; Improved Process of Handling Cream and Churning.

WISCONSIN.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN:

Bulletin No. 22, January, 1890.—Report on Oats, Barley, and Potatoes for 1889.

Bulletin No. 23, April, 1890.—Prevention of Apple Scab.

DOMINION OF CANADA.

Annual Report of the Dairy and Creamery Associations of the Province of Ontario, 1888.

Fifteenth Annual Report of the Ontario Agricultural College and Experimental Farm, 1889.

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U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

W. O. ATWATER, DIRECTOR

EXPERIMENT STATION RECORD

JULY, 1890

VOL. 1, NO. 6

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TABLE OF CONTENTS.

Page.

Editorial notes ---------- 309

Need of better methods of investigation ---------- 309

Concerning the character of Station publications ---------- 310

Abstracts of Station bulletins, July–December, 1889, Part III ---------- 312

SOUTH CAROLINA:

South Carolina Agricultural Experiment Station ---------- 312

Bulletin No. 6 (new series), July, 1889 ---------- 312

Hog cholera ---------- 312

Bulletin No. 7 (new series), October, 1889 ---------- 312

Meteorological data, Milton Whitney ---------- 312

On the development of the cotton roots ---------- 314

SOUTH DAKOTA:

South Dakota Agricultural Experiment Station ---------- 315

Bulletin No. 15, November, 1889 ---------- 315

Forestry, C. A. Keffer ---------- 315

TENNESSEE:

Tennessee Agricultural Experiment Station ---------- 315

Bulletin Vol. II, No. 3, July, 1889 ---------- 315

Cotton-seed hulls and meal as food for live stock, W. E. Stone, Ph. D ---------- 315

Bulletin Vol. II, No. 4, October, 1889 ---------- 316

Grasses of mountain meadows and deer parks, F. L. Scribner, B. S ---------- 316

Chemical composition of strawberries, W. E. Stone, Ph. D ---------- 317

Tests of varieties of strawberries, C. S. Plumb, B. S ---------- 317

Special Bulletin A, September 1, 1889 ---------- 317

The army-worm ---------- 317

Special Bulletin B, October 15, 1889 ---------- 317

Analyses of commercial fertilizers, W. E. Stone, Ph. D ---------- 317

TEXAS:

Texas Agricultural Experiment Station ---------- 318

Bulletin No. 7, November, 1889 ---------- 318

Cotton root-rot, L. H. Pammel, B. Agr ---------- 318

Bulletin No. 8, December, 1889 ---------- 319

Work in horticulture, T. L. Brunk, B. S ---------- 319

Notes on experimental vineyard ---------- 319

Experiments with strawberries ---------- 319

Notes on blackberries and raspberries ---------- 320

Notes on grasses ---------- 320

Best varieties of fruits for the different sections of Texas, with notes from correspondents ---------- 320

List of fruits growing on the experimental grounds of the Station ---------- 320

List of forest and shade trees in the College arboretum and of shrubs growing on the campus ---------- 320

VERMONT: Page.
Vermont State Agricultural Experiment Station 320
Bulletin No. 16, July, 1889 320
Testing milk at creameries 320
Bulletin No. 17, October, 1889 321
Test of dairy cows at Vermont State Fair, September 4, 1889, W. W. Cooke, M. A 321
VIRGINIA:
Virginia Agricultural and Mechanical College Experiment Station 321
Bulletin No. 2, October, 1889 321
Experiment orchard and small fruits, W. B. Alwood 321
Bulletin No. 3, November, 1889 321
Feeding experiments, D. O. Nourse, B. S 321
Meteorological record, W. H. Reynolds 322
WEST VIRGINIA:
West Virginia Agricultural Experiment Station 322
Bulletin No. 6 322
Six months' experience in running a creamery—an improved process of handling cream and churning, J. A. Myers, Ph. D 322
WISCONSIN:
Agricultural Experiment Station of the University of Wisconsin 323
Bulletin No. 20, July, 1889 323
Noxious weeds of Wisconsin, E. S. Goff 323
Bulletin No. 21, October, 1889 324
Comparative value of warm and cold water for milch cows in winter, F. H. King 324

EXPERIMENT STATION RECORD.

Vol. 1. **JULY, 1890.** **No. 6.**

EDITORIAL NOTES.

The experience of the stations is already bringing out the need of better methods of inquiry in various lines. Among these may be mentioned field experiments with fertilizers and in the cultivation of crops; tests of varieties; the analysis of feeding stuffs; and experiments in feeding.

Whoever has had experience in field experiments and has taken the pains to look through the mass of reports of such work that has accumulated during the past fifty years in Europe, as well as in this country, must be impressed with the smallness of the visible result in proportion to the expenditure of labor, thought, and money. The great difficulty is that the conditions, particularly of soil and weather, are entirely beyond not only the experimenter's control, but also his means for measuring them; and what is still worse, inequalities of soil which are hidden from his observation are often responsible for a large part of the differences in yield, so that the results give entirely wrong answers to the questions he is studying. While the importance of duplication of trials and of continuing them through a series of years can not be too strongly insisted upon, it is also very desirable that investigations should be made with special reference to the improvement of the methods of experimenting.

In experiments on the feeding of domestic animals, one chief source of error is found in the differences in the individual animals experimented upon. Indeed, it is becoming a serious question as to how far and under what circumstances a trial with a small number of animals may be relied upon for any general conclusion. It is becoming no less a question whether trials extending through short periods, a few days or weeks, have the value that has been commonly assumed for them. Again, such results as those lately reported by Professor Babcock of the Wisconsin Station, and by others, upon the variations in the quantity and composition of the milk yielded by the same cow with the same food, but under different surroundings or with different methods of milking, emphasize strongly the long-felt want of a better understanding of the physiological laws by which the production of milk is governed. The same principle applies, though in different ways, to the production of beef and pork and to the other things for which animals are bred and fed.

The need of more accurate study of the chemistry of foods and feeding stuffs has already been referred to in the publications of this Office.

Recent criticisms in the public press of one of the most interesting and valuable of the investigations reported by the stations have called attention anew to the importance of putting such accounts of the station researches and their results as are intended for the general public into form so clear, brief, and free from technical expressions that unscientific readers will easily understand them and see their value. In the case which we now have in mind the investigations were described in a report of considerable length. There was a mixture of technical details and popular explanations, of scientific discussion and practical conclusions, and though a summary was given, its style, like that of the body of the article, was verbose and obscure. It was clear that some of the criticisms referred to would not have been made if the reader had understood the real drift of the experiments. Apparently the impression left upon the minds of the critics was that, though the investigations might be interesting from a scientific standpoint, the results were of little use to the farmer. In fact, however, there was every evidence that the work had been done in a thorough, ingenious, painstaking, and decidedly creditable way, and the outcome promises to be of great and immediate practical benefit. Had the work been reported more carefully, it would doubtless have received fewer strictures and more appreciation.

The published accounts of investigations which give details in scientific form for scientific readers should be carefully distinguished from popular accounts in which the results, with needed explanations, are put into convenient shape for unscientific readers. The effort to combine the two things often results in such an abridgment of details and such illogical order in the presentation of facts that the expert is inclined to query whether the experimental work was well done, while the practical man is so confused by the mass of material and the technical terms that he is liable to miss or misunderstand the very parts which were especially intended for him.

The ideal station publications would include at least these two classes, the one for the student and investigator and the other for the practical farmer and general reader. The detailed report would contain full records of investigations, and be issued in small editions. The publications of the second class would be bulletins or other popular accounts circulated in large numbers at comparatively small expense, thus efficiently distributing the fruits of station work. Such a division of publications would secure for the stations greater sympathy and support from the farmers, and at the same time raise the estimate of the scientific value of their work among those who are qualified to judge of it. This method is, in fact, pursued by a number of stations and with very satisfactory results.

But while detailed and systematic records of experiments in small editions for men of science, and short, plain, straightforward, practical accounts for every-day workers on the farm are needed, it is not as yet practicable for all the stations to adopt a uniform system of publications. In some cases the detailed accounts are published at State expense, in annual reports to the legislature or otherwise. In addition to these a number of the stations successfully distribute short, popular bulletins at comparatively little cost. This plan in some cases works admirably. In other cases publications of only one class are attempted, either because the station has to pay the whole expense of publication,or because it wishes to avoid all expense except that which is defrayed from sources outside of its own treasury. But might not every station in some way provide popular statements of the results of its work? If it fails to do this, does it entirely fulfill its duty?

The preparing of the report of an investigation is itself an art. To make it accurate in its scientific details and at the same time clear, short, and practical is extremely difficult. To do this requires the accuracy of the investigator, the learning of the scholar, sympathetic sense of the wants of the practical man, and the highest skill in clear, terse, forcible expression.

Among the prime requisites for an investigation are a clear defining of the specific question to be studied and methods to be followed, and the accurate recording of the results. In the report of an experiment, furthermore, it is very desirable that the question, the main facts, and the conclusions be clearly and briefly summarized.

The printing of the summaries in italics or other type different from the body of the article is both attractive and useful. The reader who has only time for a hurried glance is helped and gratified by having his attention thus called to the gist of the whole matter, as well as by having it stated so briefly and so clearly that he can readily understand and remember it.

ABSTRACTS OF BULLETINS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES FROM JULY TO DECEMBER, 1889.

PART III.

SOUTH CAROLINA.

South Carolina Agricultural Experiment Station.

Department of the University of South Carolina.

Location, Columbia. Director, John M. McBryde, Ph. D., LL. D.

BULLETIN No. 6 (NEW SERIES), JULY, 1889.

HOG CHOLERA (pp. 25–31), (illustrated).—An account of this disease and its treatment, compiled in large part from the reports of the Bureau of Animal Industry of the United States Department of Agriculture. As a result of his own investigations the author obtained from diseased animals a bacillus which he regards as identical with that described by Dr. Salmon as the cause of hog cholera, as well as some other bacteria which did not appear to have any connection with this disease. The bulletin is illustrated by two photo-engravings of the ulcerated cæcum of diseased animals.

BULLETIN No. 7 (NEW SERIES), OCTOBER, 1889.

METEOROLOGICAL DATA, MILTON WHITNEY (pp. 35–51).—The meteorological conditions of the Northern and Southern States, especially the latter, as affecting the growth of staple crops, are discussed. The temperature and moisture of air and soil and their relation to the development of the cotton plant, are especial subjects of the article. For the observation of soil temperatures the author has devised a modified form of soil thermometer which records very conveniently the maximum and minimum temperatures. In lack of a satisfactory method for determining the amount of moisture in the soil the author has sought and has found, as he thinks, one which will prove satisfactory in the electrical resistance of the soil, which changes with the moisture content. Though the details of this method are not completely worked out, it has led to some very interesting observations of physical properties of the soil.

"One of these is an actual movement of soil particles, due, probably, to changing moisture content; to change of temperature; and possibly, as there is some reason to believe, the changing atmospheric pressure, which may explain in part the development of roots in the soil, the physical action of manure, and the movement of moisture in the soil."

A series of tables give results and daily observations for eight months of mean, maximum, and minimum temperature of the air, with the daily range; mean height of barometer; pressure of water vapor in the atmosphere; mean dew-point; mean relative humidity; rain-fall; maximum temperature by the solar radiation thermometer; minimum temperature by the terrestrial radiation thermometer; differences in temperature between the terrestrial radiation thermometer and the dew-point; daily wind movement; mean, maximum, and minimum temperature of the soil with daily range at depth of 3 to 9 inches, and mean weekly temperature of the soil at depths of 3, 6, 9, 12, 18, and 24 inches.

"The meteorological conditions of the Southern States are particularly well adapted to the growth of cotton and rice, neither of which can be grown economically at the North, while the yield per acre of corn, wheat, and oats is only a third of the amount obtained at the North and West. While these facts may be due in part to the methods of agricultural practice, they are undoubtedly due in large part to the general meteorological conditions of the respective localities. * * * The larger rain-fall and higher temperature at the South gives us considerable more moisture in the air, the dew-point being 10 or 12 degrees higher than at the North. This gives almost twice as much moisture in a given volume of air. * * * These differences increase as we go further south, and we find in the really tropical countries a very rank growth of vegetation, with naturally but small fruit production. In the greenhouse plants can be made to produce only foliage, or to flower, or fruit, almost at will, by regulating the moisture supply. The higher temperature and greater rainfall of the Southern States, therefore, will probably favor the production of foliage or weed rather than grain production. This will probably account, in large part, for the low average yield of corn, wheat, and oats, although where this growth is checked, as we frequently see from local causes, large crops can be produced in this State."

The application of these principles to the growth and culture of the cotton plant is discussed. Two periods in the growth of this plant may be distinguished. The first extends from the time of planting, which in South Carolina is about the middle of April, to the middle of the summer. This is the time in which the plant makes its growth of stalk and foliage and gathers up nourishment to be later transferred and stored up in the seed. During this period tropical conditions are favorable, namely, moisture in the soil from frequent rather than long-continued rain, high temperature with small daily variation, plenty of sunshine, little wind, and a high relative humidity of the atmosphere to reduce evaporation to a minimum. During this period everything possible is done to prevent loss of water from the soil; grass and weeds are scrupulously excluded, and the surface of the soil is frequently stirred with the hoe or otherwise to conserve the moisture and increase the temperature of the soil.

Now, if these conditions of high temperature and large proportions of moisture in the soil continue, the plant will keep on growing and developing stalk, will become perennial, and will produce only the coarser grades and smaller yield of cotton found in many tropical countries. But the meteorological conditions change and the plant goes through a second period of development. In the latter part of the season in South Carolina the temperature rapidly falls, the rainfall diminishes, the plant is changed from a perennial to an annual, the yield of cotton is increased, and the quality of the lint is improved. The second period is the fruiting period of the crop, when all the energies of the plant are turned to the ripening of the fruit. During this period the physical properties and conditions of the soil have an important effect upon the crop production. It then becomes important to ripen the crop and to produce the fruit instead of the stalk and foliage; in other words, cotton instead of weed. Every means is taken to dry out the soil, cultivation ceases, and the soil is allowed to become hard and compact, to favor the evaporation of the moisture. Grass and weeds are no longer feared, and rye and barley are frequently sown during the last part of the season, being supposed by many to be of value for drying out the soil. In the stiff soils or in the bottom-lands there is often an excess of moisture, and the crop matures late and often fails to open before frost.

On the islands and in the country immediately adjoining the coast the fine grades of sea-island cotton are produced. In the lower pine belt, which is farther back from the coast, and on the ridge lands, the cotton is coarser. It is urged that differences in moisture and temperature account for these differences in the crop; that the finer grades of cotton are produced only where the physical conditions of atmosphere and especially of soils are fitted for the development of the weed in the early part of the season and of the fruit in the latter part, and that in some cases physical conditions of the soil have been so improved by tillage as to make a very marked difference in the crop. The author hopes to be able to determine the differences in physical characters of some of the principal soils of the State, with a view to getting light upon the means by which the systems of tillage and culture may be so regulated as to adapt temperature and moisture of the soil to the successful growth of the finer grades of cotton.

On the development of the cotton roots.—The root system of the cotton plant is naturally small and the individual roots are small and delicate. After the first picking of cotton, eight plants which had grown on light, sandy soil having sandy subsoil, were dug up and examined. The tap-roots extended "straight down below 2 or 3 feet." The lateral roots commenced about 3 inches below the surface, and for the most part did not go below 9 inches. Out of more than twenty plants grown on heavier loam soil, with compact subsoil, only one was found with well-developed tap-root below 9 inches. Most of the lateral roots were contained within 3 to 9 inches of the surface.

SOUTH DAKOTA.

South Dakota Agricultural Experiment Station.

Department of South Dakota Agricultural College.

Location, Brookings. Director, Lewis McLouth, Ph. D.

BULLETIN No. 15, NOVEMBER, 1889.

FORESTRY, C. A. KEFFER (pp. 3–28).—This contains a weather record for thirteen months, beginning September, 1888; a diagram of the forestry plantation of the Station, with the names of varieties of trees on each plat: a brief account of the treatment which this plantation has received, and a tabular record of the growth of each variety in inches, from May to September, 1889, inclusive; a similar record for the seedling forest plat: notes on the development of roots of a few seedling trees examined; a similar record for the cuttings of several varieties and grafts of Russian poplars; a record of the growth of trees on the college lawn during 1887, 1888, and 1889; a record of the growth of eleven varieties of evergreens; notes on six varieties of evergreens grown from seed; suggestions as to the planting of trees on timber claims, and notes on fourteen varieties of trees worthy of trial in South Dakota, viz: White elm, box-elder, green ash, white birch, yellow birch, European larch, cotton-wood, a Russian poplar (*Populus certinensis*), black wild cherry, white oak, butternut, black-walnut, white pine, and Scotch pine.

TENNESSEE.

Tennessee Agricultural Experiment Station.

Department of the University of Tennessee.

Location, Knoxville. Director, Charles W. Dabney, jr., Ph. D.

BULLETIN VOL. II, No. 3, JULY, 1889.

COTTON-SEED HULLS AND MEAL AS FOOD FOR LIVE STOCK, W. E. STONE, PH. D. (pp. 47–56).—This contains an account of the results of inquiries concerning the use of cotton-seed hulls and meal as food for live stock, as practiced in the vicinity of oil mills at Memphis, New Orleans, Houston, Raleigh, Little Rock, Atlanta, and elsewhere in the South. Analyses of the hulls and meal, and of manure from animals fed on hulls and meal, are also given. The practice of feeding cotton-seed hulls to live stock seems to have begun as early as 1870, soon after the introduction of the oil industry. "But probably the first attempts at systematically feeding an exclusive ration of hulls and meal on a large scale have been made within four or five years." Thousands of cattle are now fed on these materials in the vicinity of the oil-manufacturing centers. "The hulls consist of fragments of seed-coats one-sixteenth to one-fourth inch in diameter, of dark brown color, very tough and leathery, and entangled in a mass of cotton fibers, which still adhere to the outside of the hulls and which the ginning process fails to entirely remove. It is apparently the driest and most tasteless form of animal food which could be found. In spite of this, it is said that animals which have never seen the hulls or meal before soon acquire an eager appetite for them, and after a few days prefer such a diet to one composed of hay and corn. Probably this is due to the meal rather than the hulls, which, as already noted, are well-nigh tasteless."

The chemical analyses show that the hulls contain a large excess of non-nitrogenous matter, while in the meal there is an equally large excess of protein; therefore when combined, the hulls and meal make a much better ration for stock than does either used alone.

The manure obtained from this method of feeding is quite rich in nitrogen, phosphoric acid, and potash. "Gardeners and planters in the vicinity of the stock yards are loud in their praise of its value.

"Our investigations seem to justify the following conclusions:

"(1) The practice of feeding cotton-seed hulls and meal as an exclusive diet is well established and increasing in the vicinity of the centers of the cotton-seed oil industry. All the information available indicates that the practice is economical and profitable.

"(2) It seems in no way harmful to the health of the animal nor to the healthfulness of the products (beef and milk) resulting.

"(3) The diet seems adapted both to the production of beef and mutton as well as milk.

"(4) The average ration should consist of 25 to 35 pounds of hulls and 5 to 8 pounds of meal daily.

"(5) The hulls are a cheap and effective substitute for hay.

"(6) The manure produced by this system of feeding is an important factor in considering its profitableness."

BULLETIN Vol. II, No. 4, OCTOBER, 1889.

GRASSES OF MOUNTAIN MEADOWS AND DEER PARKS, F. L. SCRIBNER, B. S. (pp. 59–67).—"The high nutritive value of the pasturage on the elevated meadows along the slopes of the mountains of Eastern Tennessee and Western North Carolina is well attested by the fat and sleek appearance of the thousands of horses, cattle, and sheep which range over these meadows from May to October." Similar conditions exist in the mountain meadows among the Rocky Mountains (where such meadows are called "deer parks") and the Alps.

In July, 1889, the author visited Roan Mountain, situated on the border line between Tennessee and North Carolina, and found on or near the summit of the mountain twenty-five species of grasses, a list of which is given in the bulletin. Notes on a number of these grasses are given, but especial attention is called to Tennessee or mountain oat grass (*Danthonia compressa*). Analyses of samples of *D. compressa* were made by the Station chemist and compared with those of *D. spicata*, orchard grass (*Dactylis glomerata*), timothy (*Phleum pratense*), and herd's grass (*Agrostis vulgaris*), made elsewhere.

"The two species of *Danthonia* make a most favorable showing beside the others, and of the two, *D. compressa* is evidently the better. In protein and fat it shows a higher percentage than any of the others, standing much higher than timothy, while with only one slight exception (herd's grass) the fiber it contains is lower. After making all due allowances for variations in samples and in conditions, the Danthonias, especially *D. compressa*, may safely be classed with our most nutritious grasses."

CHEMICAL COMPOSITION OF STRAWBERRIES, W. E. STONE, PH. D. (pp. 69–77).—This includes analyses of twenty varieties, showing the amount of water and dry matter, and the composition of the dry matter. The following table gives the average of the results obtained:

	Per cent.
Water	90.52
Dry matter	9.48
Contained in dry matter—glucose	4.78
Increase of glucose by inversion, calculated as cane sugar	0.58
Free acid, as malic	1.37
Ash	0.62
Crude fiber	1.55
Ether extract	0.64
Crude protein	0.99
Non-nitrogenous extract	5.76

TESTS OF VARIETIES OF STRAWBERRIES, C. S. PLUMB, B. S. (pp. 78–83).—Notes on twenty-four varieties are given. On the basis of quality alone the following varieties are recommended in the order given: Prince of Berries, Sharpless, May King, Bidwell, and Parry. For quality, productiveness, and salableness the following are recommended in the order given: Sharpless, Jumbo, May King, Indiana, and Jersey Queen.

SPECIAL BULLETIN A, SEPTEMBER 1, 1889.

THE ARMY-WORM (pp. 2, 3).—This was issued in response to a request from planters, made on the appearance of the army-worm in considerable numbers in the cotton fields of Western Tennessee, and contains an account of this worm and the means for its destruction.

SPECIAL BULLETIN B, OCTOBER 15, 1889.

ANALYSES OF COMMERCIAL FERTILIZERS, W. E. STONE, PH. D. (pp. 2, 3).—Analyses of samples of seven brands of commercial fertilizers sold in the State.

TEXAS.

Texas Agricultural Experiment Station.

Department of Agricultural and Mechanical College of Texas.
Location, College Station. Director, F. A. Gulley, M. S.

BULLETIN No. 7, NOVEMBER, 1889.

COTTON ROOT ROT, L. H. PAMMEL.* B. AGR. (pp. 5–30), (illustrated).—This contains an account of the conditions under which the disease occurs, the various theories regarding its origin, its general characters, the fungus thought to cause the disease, the useful plants and trees and the weeds affected by this fungus, the botanical characteristics of the fungus, other fungi found in the roots of cotton, the quality of the lint of diseased cotton, and experiments with the seeds of diseased cotton with fungicides, and in the use of fertilizers and the rotation of crops as preventives. There are also suggestions as to the treatment of infected forest and orchard trees, and a summary of fifty-seven replies from forty-seven counties in response to a circular sent out by the Station. Numerous references to American and foreign literature on this and kindred subjects are given in foot-notes. The bulletin is illustrated by five plates, with figures showing portions of diseased plants and views of the fungus in different stages. The following summary is taken, with some alterations, from the bulletin:

Root rot of cotton occurs in soils of various kinds, but is worse in black, cretaceous soils which are poorly drained. Moisture and heat are favorable to its development, but the character of the forest growth has nothing to do with this disease. "It occurs alike on the mesquite soils of Travis and Hays Counties and the post-oak lands of Eastern and the bois d'arc lands of Northern Texas." Theories as to its origin, founded on the chemical constituents of soils, and especially on the "alkali" present in many soils, are not sustained by the facts. Alkali, as the term is used, is very vague and does not apply to the Texas soils where cotton dies from root rot. In California cotton succeeds admirably on "alkali" soils, while fibrous-rooted plants do not thrive on such lands. In Texas, on the other hand, the fibrous-rooted plants, like grasses, do not die from root rot. "Seedling rot" and "sore shin" should not be confounded with root rot. "Seedling rot" affects only young plants. The bacterial disease of corn, described by Professor Burrill,† sometimes occurs in fields where cotton died the previous year from root rot, but is entirely distinct from root rot of cotton, sweet-potato, etc.

Root-rot of cotton is caused by a fungus, *Ozonium auricomum*, invariably found on roots which have died from this disease. If

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[*] Mr. Pammel is engaged in special work in botany for the Iowa Station.

[†] See Illinois Station Bulletin No. 6, an abstract of which is given in the Experiment Station Record, Vol. I, No. 4, p. 199.

plants are examined before they have wilted, a white, mold-like fungus, the early stage of *Ozonium*, will be found on the surface of the roots as well as in the medullary rays and vessels. Young plants in pots inoculated with threads of the *Ozonium* died of the disease. The wart-like bodies found on the roots of cotton and other plants affected are masses of the fungus and retain vitality for a long time. The *Ozonium* does not, however, produce the knotty bodies often found on the roots of diseased apple-trees. A large number of plants are affected by this fungus, as sweet potatoes, apple and some forest trees, and also the weed known as "common sida" (*Sida spinosa*). The *Ozonium* prepares the way for a large number of saprophytic fungi, like *Mucor* and *Penicillium*, which complete the destruction begun by the root-rot. A fungus capable of producing rot in sweet-potatoes and young cotton was isolated from rotten sweet-potatoes by the author, but he is not sure that it is connected with *Ozonium*. The lint from plants affected with root-rot is much inferior in quality. Seeds from diseased stalks showed good capacity for germination.

Treatment.—Fungicides did not check the disease, except chloride of lime, and where this was used no cotton was produced. Rotation of crops is advised as practically the only thing, so far as known, which will stop the disease. Grasses should be grown in the rotation, allowing three years to intervene before cotton is again planted. Care should be taken not to obtain plants from an infected nursery or field.

BULLETIN No. 8, DECEMBER, 1889.

WORK IN HORTICULTURE, T. L. BRUNK, B. S. (pp. 3–39).—This includes seven articles under the following heads: (1) Notes on experimental vineyards. (2) Experiment with strawberries. (3) Notes on blackberries and raspberries. (4) Notes on grasses. (5) Best varieties of fruits for the different sections of Texas, with notes from correspondents. (6) List of fruits growing in experimental grounds. (7) List of forest, shade, and ornamental trees in College arboretum and of shrubs growing on the campus.

Notes on experimental vineyard (pp. 5–16).—This includes brief accounts of the downy mildew (*Peronospora viticola*, De B.), powdery mildew (*Uncinula spiralis*, B. and C.), black rot (*Læstadia bidwellii*, Viala and Ravaz), grape-leaf blight (*Cladosporium viticolum*, Viala), leaf-spot disease (*Phyllosticta labruscæ*, Thüm.), and anthracnose (*Sphaceloma ampelinum*, De B.), with suggestions as to remedies; and notes and a tabular record for sixty-five varieties of grapes, with reference to the injury caused to them by fungi and by insects, especially the leaf roller.

Experiments with strawberries (pp. 16–21).—A tabular record of yield and period of bearing, together with descriptive notes, for twenty varieties.

Notes on blackberries and raspberries (pp. 21, 22).—Brief notes on six varieties of blackberries and four of raspberries.

Notes on grasses (pp. 22, 23).—Brief notes on tests of *Paspalum dilatatum*, *P. platycaule* (especially commended for pastures and as withstanding drouth), *P. pubiflorum*, tall fescue (*Festuca elatior*), tall meadow oat grass (*Arrhenatherum avenaceum*), orchard grass (*Dactylis glomerata*), buffalo grass (*Buchloe dactyloides*), and *Chloris verticillata*. These are in continuation of the report on experiments with 53 species in Bulletin No. 3 of this Station.

Best varieties of fruits for the different sections of Texas, with notes from correspondents (pp. 23–33).—A tabulated record of replies from thirty-one fruit growers in Texas to inquiries regarding the best varieties of grapes, apples, pears, plums, peaches, blackberries, strawberries, hedge plants, and trees for wind-breaks, with extracts from the letters of these correspondents. "It will be noticed that very few new varieties are recommended, showing that those who have the most experience prefer the old reliable varieties, that sell at the lowest prices at the nursery."

List of fruits growing on the experimental grounds of the Station (pp. 33–37).—This includes 63 varieties of apples, 27 of pears, 161 of peaches, 65 of plums, 12 of apricots, 4 of cherries, 2 of quinces, 10 of persimmons, 9 of figs, 2 of pomegranates, 5 of oranges, 2 of guavas, 1 of cassava, 96 of grapes, 6 of blackberries, 5 of raspberries, and 88 of strawberries.

List of forest and shade trees in the College arboretum, and of shrubs growing on the campus (pp. 37–39).—These include more than one hundred and fifty species.

VERMONT.

Vermont State Agricultural Experiment Station.

Department of University of Vermont.

Location, Burlington. Director, W. W. Cooke, M. A.

BULLETIN No. 16, JULY, 1889.

TESTING MILK AT CREAMERIES (pp. 2–8).—The investigations of the Station made at creameries in Vermont in 1888 showed that in eleven trials from 5 to 16 pounds, and on the average 10 pounds, out of every 100 pounds of fat actually contained in the milk, were left in the skim-milk and buttermilk, but that from 14 to 22, and on the average 18 pounds, of water and salt were added to the 90 pounds of fat obtained in the butter; so that the amount of marketable butter ranged from 101 to 115 pounds, and averaged 108 pounds.

Short's method of determining fat in milk was tried at the Station with fairly good results. It was found desirable, however, to heat the milk longer than the instructions given for the use of this method prescribed. Attention is called to the necessity of being sure that the tubes for this method furnished by dealers are reliable.

At the creameries in this State the milk or cream is paid for either on the basis of the quantity delivered, without regard to the amount of butter fat it contains or the amount of butter made from it; or by the amount of butter produced. The object of Short's and other similar methods is to determine the actual amount of fat in the milk or cream delivered, and use this as a basis of payment. The methods of calculating the sum to be paid the dairyman on this latter basis are illustrated and tables given to facilitate calculations.

BULLETIN No. 17, OCTOBER, 1889.

TEST OF DAIRY COWS AT VERMONT STATE FAIR, SEPTEMBER 4, 1889, W. W. COOKE, M. A. (pp. 3–15).—This gives an account of a competitive test, under direction of the Station, of the milk and butter from nine cows of three different breeds, with tabular records of the results. There is also a table showing the results of tests of milk of six of the same cows at home. Difficulties connected with the transportation of the cows to the fair grounds and the handling of the milk there, as well as the fact that the cows did not do as well at the fair as at home, interfered with the success of the trial.

VIRGINIA.

Virginia Agricultural and Mechanical College Experiment Station.

Department of Virginia Agricultural and Mechanical College.

Location, Blacksburg. Director, William B. Preston.

BULLETIN No. 2, OCTOBER, 1889.

EXPERIMENT ORCHARD AND SMALL FRUITS, W. B. ALWOOD (pp. 3–15).—An account of the arrangement of the Station's experimental orchard of 15 acres, and a list of varieties of fruits under culture, including 106 varieties of apples, 11 of crab-apples, 4 of quinces, 32 of pears, 43 of peaches, 33 of plums, 4 of apricots, 5 of nectarines, 20 of cherries, and 3 of Japanese persimmons; 23 varieties of raspberries, 14 of blackberries, 8 of currants, 5 of gooseberries, 56 of strawberries, 82 American and European varieties of grapes, and 21 species of wild grapes.

BULLETIN No. 3, NOVEMBER, 1889.

FEEDING EXPERIMENTS, D. O. NOURSE, B. S. (pp. 3–10).—In view of the present unprofitableness of stock raising in Virginia, this Station proposes to give considerable attention to feeding experiments with steers, hogs, and sheep.

In the experiment reported in this bulletin eighteen steers from the Station herd were used. They were divided into nine lots of two animals each, and each lot was fed a different ration. The feeding stuffs, which were fed in various combinations, were hay, corn meal, bran, cotton-seed meal, whole corn, silage, and roots. No analyses of the feeding stuffs are given. The feeding period was only five weeks, besides a preliminary period of ten days. Details are given in eight tables, the data including weight of steers, total amount of food and of dry matter eaten, dry matter eaten and increase in weight per 100 pounds of live weight, ratio of gain or loss in live weight to dry matter eaten, cost of feed for whole period and per pound of increase of live weight. In summing up the experiment it is stated that, taking the value of the manure into account, the cost of the feed was about the same for each animal; the greatest increase was with a ration of a wide nutritive ratio; the most economical food was corn meal, or whole corn, hay, and silage; and the cost per pound of increase in live weight varied from 8 to 29 cents.

METEOROLOGICAL RECORD, W. H. REYNOLDS (pp. 11–16).—A tabular record of daily observations of the temperature of the air and soil, barometric pressure, dew-points, and atmospheric humidity during July, August, and September, 1889.

WEST VIRGINIA.

West Virginia Agricultural Experiment Station.

Department of West Virginia University.

Location, Morgantown. Director, John A. Myers, Ph. D.

BULLETIN No. 6.

SIX MONTHS' EXPERIENCE IN RUNNING A CREAMERY—AN IMPROVED PROCESS OF HANDLING CREAM AND CHURNING, J. A. MYERS, PH. D. (pp. 142–152).—In its efforts to promote the dairy interests of West Virginia the Station has found it necessary to work along the following lines: (1) to convince the farmers that it would probably pay them to patronize creameries; (2) to create a market for West Virginia creamery butter; (3) to obtain reasonable rates and facilities from railroads and express companies; (4) to overcome the difficulties incident to any new commercial enterprise; (5) to demonstrate to the farmers that it is possible by a proper management of their cows to conduct a creamery through the winter as well as through the summer; (6) to advance our knowledge of the chemistry of milk and butter, and to improve upon the methods of handling both these products. The difficulties experienced in gaining the confidence of the farmers, commission merchants, and customers are described. The Station creamery has succeeded in securing a demand for its products which exceeds its ability to supply, and whereas when the Station began this work, less than two years ago, there was only one creamery in the State, now there are at least six. The composition of milk and butter is explained, and the losses which occur in handling butter and in failing to separate all the fat from the milk are discussed. The figures of Prof. C. W. Wulff,* of the Indiana Station, on this latter point are given and commented on.

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* See Dairy World, Vol. VIII, No. 6, p. 233.

The difference in the butter yield from different cows is also calculated. It is shown that if there is an average difference of 1.25 per cent in the fat in the milk of two cows, each yielding 6,000 pounds of milk a year, there will be a difference of $22.50 a year in the receipts for the butter from these cows when butter averages 30 cents a pound. This calculation allows for a loss of .22 per cent of fat in the buttermilk due to the imperfect extraction of the fat in churning. This is a much smaller loss than occurs in the ordinary handling of milk at farmhouses. The Station attempted to save this waste and at the same time improve the butter by churning sweet cream, but found the loss of fat in the buttermilk under this system as ordinarily managed much larger than when the ripened cream was churned. It then occurred to the creamery man, Mr. A. C. Magruder, that by running the sweet buttermilk through the separator more of the fat could be secured. This method proved to be very successful, only a trace of fat (less than .1 per cent) being left in the buttermilk, as shown by the lacto-butyrometer, lactocrite, and by Short's method.

By this process, it will be seen that the milk is skimmed by the separator until the butter fat is extracted almost to within the limits of chemical analysis. The quality of the butter is maintained and it is all handled in the granulated condition just as if it had been churned in the usual way.

The milk at the creamery is delivered sweet every morning, and embraces the evening and morning milkings. When the weather is sufficiently warm to cause the milk to sour, the milkings are brought to the creamery in separate vessels. The milk as delivered by the farmers is immediately run through the separator, and about one-fifth thrown out as cream. The other four-fifths is taken home by the farmers as skim milk. As soon as we are done separating, the cream is cooled to from 50 to 55 degrees to remove the animal heat and reduce it to the proper temperature for churning. It is then put into a Blanchard revolving churn and churned at from thirty-eight to forty revolutions to the minute until the butter granulates in the usual manner, when the churn is stopped and the buttermilk is drawn off and again run through the separator, as mentioned.

* * * It remains to be tried in other creameries and tested in other laboratories as to whether the process is worthy of general acceptation. With us it has worked well.

WISCONSIN.

Agricultural Experiment Station of the University of Wisconsin.

Department of University of Wisconsin.

Location, Madison. Director, W. A. Henry, B. Agr.

BULLETIN No. 20, JULY, 1889.

Noxious weeds of Wisconsin, E. S. Goff (pp. 3–29).—The text of the amended weed law of this State, approved April 16, 1889, is given. The first section reads as follows:

Section 1. Every person and corporation shall destroy upon all lands which he or they shall own, occupy, or control, all weeds known as Canada thistles (*Cirsium arvensis*), burdock (*Lappa officinalis*), white or ox-eye daisy (*Leucanthemum vulgare*), snapdragon or toad-flax (*Linaria vulgaris*), cocklebur (*Xan-*

> *thium strumarium*), sow-thistle (*Sonchus arvensis*), sour-dock and yellow dock (*Rumex crispus*), at such time and in such manner as shall prevent their bearing seed. In like manner shall he or they also destroy any of the above-mentioned weeds standing or growing as far as the center of the public highways, lands or alleys adjoining the lands owned or controlled by him or them.

The law provides for the appointment of commissioners to destroy the weeds on lands neglected by the owners and for the addition of the expenses involved to the taxes levied upon these lands, the object being to prevent the spread of weeds from the lands of negligent owners to those of persons who carefully obey the law. The species of weeds named in the law and six others are described and illustrated in this bulletin, and suggestions made as to the best methods for their eradication.

BULLETIN No. 21, OCTOBER, 1889.

COMPARATIVE VALUE OF WARM AND COLD WATER FOR MILCH COWS IN WINTER, F. H. KING (pp. 3–30).—The chief object of the experiments here reported was to ascertain whether it is true, as many farmers believe, that warm water increases the yield of milk, and if so, whether this increase affects the volume simply or the weight of the solids contained to an extent which would make it remunerative in general practice to warm the water for cows.

Six cows were placed in stanchions side by side in two groups of three each, and fed a daily ration of 5 pounds of bran mixed with 2 pounds of ground oats and 6 pounds of hay, together with what dry cut fodder they would eat up clean from January 21 to March 25. During this time the cows in every way received similar treatment, except that when one group of cows received water at 32° F., the other received it at 70° F. The experiment was divided into three periods of sixteen days each, having intervals between them. At the close of the first and second periods the temperatures of the water were reversed for each of the cows in order to eliminate, so far as might be, the individual differences of the two groups.

Details are given in a number of tables and described at considerable length. A more complete record of this experiment may be found in the sixth annual report of this Station for 1889.

The following summary of results " for these six cows while under experiment " is taken from the bulletin:

(1) While on warm water they gave on the average 1.002 pounds of milk per cow per day more than while on cold water, or 6.23 per cent of the general average daily yield of 16.06 pounds.

(2) They drank on the average, daily, while on cold water, 63 pounds, but while on warm, 73 pounds, or 10 pounds more per cow.

(3) They ate more while on warm water than while on cold, and at the rate of 0.74 pound of corn fodder per cow per day.

(4) An increase in the amount of water drunk was coincident with an increase in the quantity of milk given, and this was true irre-

spective of whether the water was warm or cold, an increase of 10 pounds in every 100 pounds of water drunk, being accompanied by an increase of nearly 1 pound in every 100 pounds of milk given.

(5) The cows consumed solid food while on warm water at the rate of 1.44 pounds for each pound of milk produced, and while on cold water at the rate of 1.54 pounds.

(6) An increase in the amount of water drunk, when the temperature of the water remained the same, was associated with an increase in the amount of water in the milk without a notable increase in the total solids.

(7) An increase in the temperature of the water drunk, when the quantity remained the same, was associated with an increase in the total amount of solids produced.

(8) There was a daily fluctuation in the percentage of water in the milk associated with a fluctuation in the amount of water drunk.

(9) Five cows manifested a strong preference for water at 70° over that of 32°, but one of the cows showed an even stronger liking for the iced water.

(10) With but one exception the cows, while they ate less and drank less during the cold water periods, weighed more at their close, and with but three exceptions weighed less at the close of the warm water periods.

(11) With butter at 20 cents per pound, skim-milk at 25 cents per cwt., corn fodder at $5 per ton, and the cost of warming water for forty cows one hundred and twenty days at $15, the results obtained from the cows in this experiment indicate that a net gain of $21.36 would be realized on a herd of forty cows averaging 16 pounds of milk per cow per day, and at least $10 on a herd of twenty, and $5 on a herd of ten cows. Counting corn fodder at $10 per ton, the net gain on a herd of forty cows would still be $12.48.

INDEX OF NAMES.

Adams, L. H., 165.
Adriance, D., 153.
Almy, F. F., 123.
Alvord, H. E., 60, 74, 75, 222.
Alwood, W. B., 58, 321.
Anthony, L. E., 195, 196.
Armsby, H. P., 30, 60, 142, 295, 296.
Arnold, A. P., 132.
Arthur, J. C., 36, 207, 252.
Atherton, George W., 57.
Atkinson, G. F., 146, 184, 185.
Atwater, W. O., 18, 58, 65, 192.
Babcock, S. M., 161, 309.
Bailey, E. A., 192, 195.
Bailey, L. H., 89, 271, 276, 283.
Battle, H. B., 136, 138, 283, 284.
Beal, W. J., 86, 209, 228.
Beckwith, M. H., 22, 196.
Bedford, P. A., 246.
Bessey, C. E., 118, 252, 253, 254.
Billings, F. S., 108, 123, 199, 200.
Bishop, W. H., 74.
Black, J. J., 195, 196.
Blair, W. M., 246.
Blount, A. E., 248.
Bolley, H. L., 204.
Bollinger, Prof., 139.
Bolton, B. M., 107.
Bozarth, C., 44.
Brace, D. B., 123.
Brown, G. T., 100.
Bruner, L., 60, 120.
Brunk, T. L., 319.
Budd, J. L., 213.
Burrill, T. J., 33, 107, 199, 200, 318.
Butz, G. C., 295.
Caldwell, G. C., 278.
Caldwell, W. H., 142, 143, 296.
Calhoun, L. M., 71.
Campbell, J. P., 26, 27.
Cassidy, J., 10.
Chamberlain, J. R., 286.
Chester, F. D., 23, 196.
Clark, E. F., 146.
Clark, J. W., 102.
Clayton, J., 184.
Clute, O., 84, 118, 226.
Collier, P., 265, 266, 269.
Comstock, J. H., 73, 277.
Conn, H. W., 164, 192.
Connell, J. H., 63.
Cook, A. J., 91, 226, 227.
Cook, G. H., 131, 258.
Cooke, W. W., 155, 156, 157, 320, 321.
Cornwall, H. B., 239.
Cottrell, H. M., 216.
Craig, J., 44.
Crampton, C. A., 235, 238.
Crandall, C. S., 89.
Creelman, G. C., 101.
Curtis, G. W., 151.
Cushman, S., 296, 297.
Cutter, W. P., 135, 136, 248, 282.
Dabney, jr., C. W., 148, 315.
Dancy, F. B., 238, 283, 285.
De Pass, J. P., 25, 118, 197.
Detmers, H. J., 103, 108, 139.
Devol, W. S., 127, 255.
Dodge, C. R., 299.
Dudley, W. R., 281, 282, 283.
Earle, J. J., 25, 197, 198.
Edson, H., 236.
Eggleston, N. H., 59.
Ellis, G. H., 110.
Ellis, J. B., 36.
Fairchild, G. T., 60, 118.
Fernald, C. H., 82, 224, 225.
Fernow, B. E., 109.
Flagg, C. O., 145, 146, 296.
Fletcher, J., 246.
Forbes, S. A., 60.
Foster, Luther, 18, 19.
Francis, O. W., 248.
Franklin, S. M., 119.
Frear, W., 145.
French, H. T., 86.
Galloway, B. T., 150, 168, 169, 170.
Garman, H., 60, 219.
Gates, M. E., 60, 118, 130, 256, 260.
Georgeson, C. C., 36, 247.
Gilbert, A. G., 246.
Gillette, C. P., 45, 60, 211, 213.
Goessmann, C. A., 77, 79, 80, 81, 82, 222.
Goff, E. S., 169, 323.
Goodell, H. H., 82, 224.
Graham, I. D., 118.
Gray, Asa, 297.
Green, S. B., 93, 94, 95, 99, 232.
Green, W. J., 287, 293, 294.
Grimm, E., 142, 294.
Grunow, H., 143.
Gulley, F. A., 60, 151, 152, 318.
Hadley, Hiram, 57, 119.
Halsted, B. D., 43, 130, 134, 169, 263, 264, 265.
Harper, D. N., 98, 99.

Harrington, H. H., 153.
Harrison, B., 84.
Hart, J. W., 184.
Harvey, F. L., 73, 74.
Hays, W. M., 91, 97, 98, 229, 230.
Henry, W. A., 161, 164, 323.
Hickman, J. F., 139, 141, 287, 289.
Hicks, L. E., 118, 120, 252.
Hilborn, W. W., 246.
Hilgard, E. W., 10, 60, 189.
Holes, J., 248.
Housell, C. M., 262.
Humphrey, J. E., 81, 225.
Hunt, T. F., 28, 34, 202.
Huston, H. A., 37.
Ingersoll, Charles L., 10, 13, 190.
Irby, B., 233.
Irish, P. H., 295.
Jenkins, E. H., 58, 60, 197.
Jensen, Prof., 216.
Johnson, S., 84, 86, 87.
Johnson, S. W., 14, 191.
Jones, S. A., 127, 255.
Jones, W. L., 26, 27.
Jordan, W. H., 73.
Kedzie, R. C., 90, 226, 227.
Keffer, C. A., 19, 20, 315.
Kellerman, W. A., 169, 216.
Kellner, O., 247.
King, F. H., 324.
Kinney, L. F., 297.
Knowles, E. L., 169.
Koebele, A., 301.
Kozai, Y., 247.
Lake, E. R., 142, 294.
Latta, W. C., 37, 206.
Law, J., 103.
Ledoux, A. R., 23.
Lee, S. D., 60.
Lowell, J., 248.
Lugger, O., 94, 230.
Lupton, N. T., 4, 7, 184.
Lyon, S. S., 248.
Lyon, T. T., 228.
McBryde, J. M., 146, 312.
McCarthy, G., 137, 286.
McCluer, G. W., 33.
Mackay, A., 246.
McLain, N. W., 91, 95, 118, 229.
McLouth, L., 18, 315.
Magruder, A. C., 160, 161, 323.
Manns, A. G., 200.
Maynard, S. T., 82, 225.
Mell, P. H., 4, 7, 183, 184.
Menke, A. E., 8, 188.
Merriam, C. H., 60, 108.
Morgan, J. T., 59.
Morrow, G. E., 28.
Myers, J. A., 160, 322.
Neal, J. C., 197, 198.
Neale, A. T., 22, 58, 195, 196.
Nehring, A. M., 100.
Nelson, J., 134.
Newman, J. S., 3, 5, 8, 183, 187.
Newman, W. H., 187.
Nobbe, F., 175.
Nourse, D. O., 321.
O'Brine, D., 11, 13, 191.
Orcutt, I. H., 21.
Osborn, H., 44.
Packard, A. S., 297.
Pammel, L. H., 318.
Patrick, G. E., 42, 44, 210.
Peabody, S. H., 28, 199.
Penny, C. L., 197.
Phares, D. L., 233.
Pickell, J. M., 25, 197, 198.
Pillsbury, J. S., 94.
Plumb, C. S., 317.
Porter, E. D., 91, 94, 95, 118, 249.
Poumeroulie, C., 94.
Pound, R., 253.
Power, J. B., 248.
Pratt, R. H., 59.
Prentiss, A. N., 282.
Preston, W. B., 158, 321.
Reagan, J. H., 59.
Redding, R. J., 69, 119, 198.
Reynolds, W. H., 322.
Richman, E. S., 248.
Riley, C. V., 301.
Rivolta, S., 123.
Roberts, I. P., 134, 135, 271, 273, 279, 280, 283.
Rogers, ——, 127.
Ross, B. B., 221.
Ross, L., 7, 184.
Salmon, D. E., 103, 312.
Samford, T. D., 4.
Sanborn, J. W., 101, 118, 119, 249, 250.
Satterthwaite, S. T., 248.
Saunders, W. H., 57, 246.
Schwartzkopff, O., 100.
Schweitzer, P., 101, 251.
Scott, W. H., 60.
Scovell, M. A., 60, 61, 218.
Scribner, F. L., 150, 316.
Sewall, J. A., 168.
Shakespeare, E. O., 107.
Sharpe, T. A., 246.
Shelton, E. M., 46, 118, 214, 215, 216.
Shepard, J. H., 22.
Short, F. G., 165.
Shutt, F. T., 246.
Smart, J. H., 60.
Smith, E. F., 169.
Smith, J. B., 134, 260, 261, 264.
Smith, J. G., 121, 254.
Smith, L. P., 210.
Snow, E. M., 103.
Snow, Miss J. W., 281.
Speer, R. P., 42, 209, 211, 212.
Spencer, G. L., 235.
Spencer, J. W., 26.
Stockbridge, H. E., 35, 204.
Stone, W. E., 148, 315, 317.
Strahan, C. M., 198.
Stubbs, W. C., 63, 220, 221.
Sutton, G., 103.
Swingle, W. T., 169, 216.
Taft, L. R., 89.
Thaxter, Roland, 15.
Thompson, H. P., 132.
Thorne, C. E., 138, 141, 287.

Tracy, S. M., 101, 233.
Tratman, E. E. R., 109, 110.
Troop, J., 35, 209.
Van Landeghem, P., 36.
Vasey, G., 168.
Von Wolff, E., 37.
Voorhees, E. B., 131, 132, 256, 259, 261, 264.
Walker, P., 302.
Warner, C. D., 225.
Washburn, F. L., 295.
Webber, H. J., 253.
Weber, H. A., 239.
Webster, F. M., 41.
Wedderburn, A. J., 237.
Weed, C. M., 138, 290, 291, 292, 294.
Wheeler, H. J., 296.
Whitcher, G. H., 127, 130, 255.
White, H. C., 26, 27.
Wickson, E. J., 190.
Wiley, H. W., 237, 300.
Willis, B., 59.
Willits, E., 58, 81, 118.
Wing, H. H., 120, 273, 279, 280.
Woods, A. F., 253.
Woods, C. D., 194.
Woodworth, C. W., 9.
Wooton, E. O., 248.
Wulff, C. W., 37, 40, 322.

INDEX OF SUBJECTS.

NOTE.—This index is intended to serve as a guide to the contents of the station bulletins for 1889, which are referred to by page and number in the body of the Record.

Page.

- *Acer rubrum*, analysis of, Ga. Sta 26
- Acid phosphate, effects on sugar-cane, La. Sugar Sta 68
  - field experiments with, Ga. Sta 26
- *Acrobasis vaccinii*, notes on, N. J. Sta 131
- *Acronycta populi*, distinguished from *A. lepusculina*, Minn. Sta 232
- *Actinonema rosæ*, notes on, Mass. Hatch Sta 225
  - remedy for, Mass. Hatch Sta 83
- Adulterations of food, account of, U. S. D. A. 237
- Æcidia of wheat rust, Ind Sta 204
- *Ægeria tipuliformis*, notes on, Colo. Sta 12
- Agarics, North American, U. S. D. A 169
- Agricultural Congress, International, at Vienna 246
  - investigations, factors in, Ga. Sta 26
- *Agropyrum tenerum*, for sandy soils, Mich. Sta 228
- *Agrostis vulgaris*, notes on, Tenn. Sta 317
- *Agrotis*, genus, notes on, Nebr. Sta 120
- Alabama, Agricultural and Mechanical College of 3, 8, 183, 187
  - Canebrake Experiment Station 8, 187
    - Station bulletins 8, 187
  - College Experiment Station 3, 183
    - Station bulletins 3, 183
- Alfalfa, acquisition of nitrogen from air by, Conn. Storrs Sta 194
  - as forage plant 59
  - digestion experiments with, Colo. Sta 190
  - field experiments with, Nebr. Sta 122, 254
  - growth, composition, and digestibility, Colo. Sta 190
  - in feeding experiments for beef, N. Y. State Sta 270
  - notes on, N. Y. State Sta 266
- Alkali lands of San Joaquin Valley, Cal. Sta 189
  - soils of Colorado, Colo. Sta 191
- Alsike clover, field experiments with, Nebr. Sta 122
- *Alypia octomaculata*, notes on, Colo. Sta 11
- Amara beetles as locust parasites, Minn. Sta 232

Page.

- Ammonia, determination of, N. Y. Cornell Sta 136
  - loss during drying of stable manure, N. C. Sta 138
  - sulphate, analyses of, Conn. State Sta 15
    - as fertilizer for corn—
      - Ill. Sta 33
      - Vt. Sta 156
    - as fertilizer for wheat, Va. Sta 158
    - cost of nitrogen from, Conn. State Sta 16
    - field experiments with, Ala. College Sta 3
    - for home-mixed manures, N. H. Sta 129
- *Amphicerus bicaudatus*, notes on, Nebr. Sta. 120
- Analyses, animal manures, Tenn. Sta 149
  - apple pomace, Conn. State Sta 15
    - twigs, Iowa Sta 42
  - ashes, Conn. State Sta 191
    - Fla. Sta 198
    - Ga. Sta 26, 27
    - Mass. State Sta 80
    - N. Y. Cornell Sta 282
  - baking powders, U. S. D. A 239
  - barley screenings, Conn. State Sta. 15
  - bean, white soja, Mass. State Sta 79
  - beets, Ind. Sta 36
  - bone, Mass. State Sta 80
    - ground, N. J. Sta 259
  - brewers' grains, Conn. State Sta 15
  - buckwheat middlings, Conn. State Sta 15
  - chaff, Mass. State Sta 80
  - chicken corn, Miss. Sta 233
    - silage, Miss. Sta 233
  - clover, Ill. Sta 311
    - Vt. Sta 167
  - coal, Ala. College Sta 4
    - bituminous, La. State Sta 221
    - dust, Mass. State Sta 80
  - commercial fertilizers—
    - Ala. College Sta 4, 7, 184
    - Ark. Sta 9
    - Conn. State Sta 19
    - Fla. Sta 25
    - Ind. Sta 37

Page.
Analyses, commercial fertilizers—
Ky. Sta ... 218
La. State Sta ... 69, 221
Me. Sta ... 73
Mass. State Sta ... 80, 82
Mich. Sta ... 226
N. J. Sta ... 256, 258, 259
N. C. Sta ... 136, 138
Pa. Sta ... 145
Tenn. Sta ... 149, 317
Vt. Sta ... 155
concentrated egg producer, Conn. State Sta ... 15
feed for live stock, Conn. State Sta ... 15
condimental cattle food, N. Y. Cornell Sta ... 282
corn, Conn. State Sta ... 15
germ, N. Y. Cornell Sta ... 282
meal, N. H. Sta ... 255
plant at different stages of growth, Mo. Sta ... 251
cotton-seed bran, Conn. State Sta ... 15
hull ashes, Mass. State Sta ... 80
N. Y. Cornell Sta ... 282
Tenn. Sta ... 149
hulls, Ark. Sta ... 9
N. Y. Cornell Sta ... 282
Tenn. Sta ... 315
meal, Conn. State Sta ... 15
Ga. Sta ... 198
Mass. State Sta ... 80
N. H. Sta ... 255
N. Y. State Sta ... 267
Tenn. Sta ... 149, 315
cranberry vines, Mass. State Sta ... 80
dairy products, Ala. College Sta ... 7
dried fish, N. J. Sta ... 260
feeding stuffs, Ala. College Sta ... 7
Del. Sta ... 197
Ga. Sta ... 198
N. Y. State Sta ... 267
Tex. Sta ... 153
fodder materials, Mass. State Sta ... 79
Glen Cove starch feed, Conn. State Sta ... 15
gluten, N. H. Sta ... 255
meal, Conn. State Sta ... 15
La. State Sta ... 221
No. 1 feed, Conn. State Sta ... 15
grass and hay, Ala. College Sta ... 183
grasses, Ill. Sta ... 34
N. Y. State Sta ... 267
ground bone, N. J. Sta ... 259
guano, La. State Sta ... 221
bat, Fla. Sta ... 198
fish, N. J. Sta ... 260
Mona Island, Mass. State Sta ... 80
gypsum, Fla. Sta ... 198
hay, Conn. State Sta ... 15
Ga. Sta ... 198

Page.
Analyses, hay, Ill. Sta ... 34
(salt), Mass. State Sta ... 80
Miss. Sta ... 233
Nebr. Sta ... 255
Vt. Sta ... 157
hominy chops, Conn. State Sta ... 15
Kaffir corn, Pa. Sta ... 143
limestone, La. State Sta ... 221
linseed meal, Conn. State Sta ... 15
Mass. State Sta ... 80
refuse, Mass. State Sta ... 80
malt sprouts, Conn. State Sta ... 15
N. Y. Cornell Sta ... 282
marls, Ala. College Sta ... 184
Fla. Sta ... 25
La. State Sta ... 221
Tenn. Sta ... 149
middlings, Conn. State Sta ... 15
N. H. Sta ... 255
milk, Mass. State Sta ... 15
N. Y. Cornell Sta ... 281
muck, Fla. Sta ... 25, 198
mud crab, Mass. State Sta ... 80
oat bran, Conn. State Sta ... 15
oats, Conn. State Sta ... 15
Pamunkey marl phosphate, N. C. Sta ... 138
peat, Mass. State Sta ... 80
pea-vine silage, Miss. Sta ... 233
phosphates, Ala. College Sta ... 184
plaster, Tenn. Sta ... 149
prickly comfrey, Pa. Sta ... 143
rice products, La. State Sta ... 221
rye bran, Conn. State Sta ... 15
shorts, Conn. State Sta ... 15
N. H. Sta ... 255
silage corn, Ill. Sta ... 29
N. Y. State Sta ... 265
soil, Mass. State Sta ... 80
Mo. Sta ... 101
Ala. College Sta ... 7
Fla. Sta ... 198
soils and subsoils, Ala. College Sta ... 4, 7
Fla. Sta ... 25
soot, N. Y. Cornell Sta ... 282
sorghum juices, Iowa Sta ... 44
silage, Miss. Sta ... 233
Sorghum vulgare, Miss. Sta ... 233
starch feed, Conn. State Sta ... 15
strawberries, Tenn. Sta ... 317
superphosphates, N. J. Sta ... 260
sylvanit, Conn. State Sta ... 191
sweet-potato vines, Ga. Sta ... 198
tankage, Mass. State Sta ... 80
Tenn. Sta ... 149
tannery waste, Tenn. Sta ... 149
teosinte silage, Miss. Sta ... 233
tobacco stems, Conn. State Sta ... 15
Thomas slag, N. J. Sta ... 260
Tenn. Sta ... 149
tomatoes, N. J. Sta ... 262
turf, Mass. State Sta ... 80
water, Fla. Sta ... 197
(artesian well), La. State Sta ... 221

Page.
Analyses, wheat bran, Conn. State Sta 15
Ga. Sta 198
N. Y. Cornell Sta 282
wheat, frosted and rusted, Minn. Sta 99, 100
wheat products, Minn. Sta 230
white mustard, Pa. Sta 113
wool waste, Mass. State Sta 80
Analysis, methods for baking powders, U. S. D. A 239
cattle foods, N. Y. Cornell Sta 278
Andropogon provincialis, notes on, U. S. D. A 168
scoparius, notes on, U. S. D. A. 168
Anguillula arenaria, Ala. College Sta 185
radicicola, Ala. College Sta 185
Animal Industry, Bureau of, U. S. D. A 105
Anisota rubicunda, notes on, Nebr. Sta 120
Anthracnose of grapes, notes on, Tex. Sta. 319
U. S. D. A. 170
Anthrenus scrophulariæ, notes on, Mass. Hatch Sta 224
Antiopa butterfly, notes on, Minn. Sta 232
Ants, notes on, Mass. Hatch Sta 224
Aphis forbesi, notes on, Ohio Sta 291
Aphis, grain, brief account of, Ind. Sta 41
green, treatment, Oregon Sta 294
wheat, enemies of, Mich. Sta 226
woolly, treatment, Oregon Sta 294
Apiaries, notes on management of, R. I. Sta 297
Apiarist, report of, R. I. Sta 297
Apiculture at Ontario experimental farm 216
Apparatus, chemical, for drying substances in hydrogen, N. Y. Cornell Sta 278
for extraction of fat, N. Y. Cornell Sta 278
Apple, bitter rot of, treatment, U. S. D. A 169
leaf beetle, notes on, Colo. Sta 11
Nebr. Sta 120
maggot, notes on, Me. Sta 73
orchard, treatment of, Ky. Sta 63
pomace, analyses of, Conn. State Sta 15
powdery mildew, treatment of, U. S. D. A 170
scab and rust, treatment of, U. S. D. A. 168, 170
scab, treatment of, Ohio Sta 294
U. S. D. A 169
Apple-tree borer, remedies for, Ohio Sta 13
pests, remedies for, Colo. Sta 11
tent caterpillar, notes on, N. Y. Cornell Sta 283
Apple-trees, conditions of hardiness, Iowa Sta 43
tests for maturity, Iowa Sta 43
Apple-twig borer, notes on, Nebr. Sta 120
Apple twigs, chemical study of, Iowa Sta 42
Apples, preservation of early *vs.* late pickings, Ohio Sta 287
report on Missouri Agricultural College collection, Mo. Sta 102
Russian varieties, Mass. Hatch Sta. 84
test of keeping qualities of different varieties, Mo. Sta 102
varieties, Mich. Sta 229

Page.
Aquatic leaf beetle, notes on, Ohio Sta 292
Arbor vitæ, notes on, S. Dak. Sta 20
Arkansas Agricultural Experiment Station 8, 188
Industrial University 8, 188
Station bulletins 8, 188
Army worm, notes on, Nebr. Sta 120
Tenn. Sta 317
Arrhenatherum avenaceum—
adaptability to Alabama, Ala. College Sta 183
notes on, Tex. Sta 320
Arsenic, white, effects on foliage, Mich. Sta 227
Arsenites for codling moth, Colo. Sta 11
plum curculio, Mich. Sta 227
Ohio Sta 290
Arzama obliquata, notes on, Ohio Sta 292
Ascochyta fragariæ, notes on, N. Y. Cornell Sta 282
Ash analyses of native woods, Ga. Sta 26, 27
crude, in corn fodder, Ill. Sta 29
in hay products, Ill. Sta 34
green, notes on, S. Dak. Sta 315
trees, notes on, S. Dak. Sta 20, 315
wood, analysis, Ga. Sta 26
Ashes, analyses, Conn. State Sta 191
Fla. Sta 198
Ga. Sta 26
Mass. State Sta 80
N. Y. Cornell Sta. 282
beneficial effects upon land, Conn. State Sta 192
cotton-seed hull—
analyses of, Tenn. Sta 149
as fertilizer, Ala. Canebrake Sta 187, 188
field experiments with, N. Y. Cornell Sta 283
Asparagus beetle, notes on, Del. Sta 22
Association of American Agricultural Colleges and Experiment Stations—
officers for 1890 60
third annual convention 57
Association of Official Economic Entomologists, meeting of 60
Attagenus piceus, notes on, Mass. Hatch Sta 224
Ayrshire cattle—
dairy test of, N. J. Sta 258
Vt. Sta 321
feeding test of, N. Y. State Sta 270
Bacteria in milk and its products, Conn. Storrs Sta 192
of hog cholera, S. C. Sta 312
U. S. D. A 103
Bacterial disease of corn, Ill. Sta 199
Baking powders, character and composition of, U. S. D. A 238
Bamboo shoots, constituents of 247
Barley, damaged, experiments in germination and growth, Minn. Sta 95
field experiments with, Mass. State Sta 80
S. Dak. Sta 19
frosted, germination of, S. Dak Sta. 19
germination tests of, Pa. Sta 295
in feeding experiments, Mass. State Sta 77

Page.

Barley, screenings, analyses of, Conn. State Sta 15
varieties, La. State Sta 69
Mich. Sta 87
Pa. Sta 142, 143
Basswood trees, notes on, S. Dak. Sta 20
Bean, anthracnose of, treatment of, U. S. D. A. 169
new prolific tree, notes on, Iowa Sta. 212
white soja, analyses, Mass. State Sta 79
Beans, varieties, Ala. State Sta 184
Iowa Sta 212
Mass. Hatch Sta 84
Nebr. Sta 254
Bee fly, as a locust parasite, Minn. Sta 231
hives, notes on improvements in, R. I. Sta 296
keeping, legality of, R. I. Sta 297
notes on, R. I. Sta 296
Bees, varieties of, R. I. Sta 296
Beetle living in an insecticide, Ind. Sta 41
Beets, analyses of, Colo. Sta 14
Ind. Sta 36
germination tests of, Pa. Sta 295
in feeding experiment with milch cows, Mass. State Sta 223
varieties, Colo. Sta 14
Ind. Sta 36
Mich. Sta 87
Nebr. Sta 123, 254
S. Dak. Sta 22
vs. silage for milk production, Ohio Sta 141
Belostoma americanum, notes on eggs of, Ohio Sta 292
Benacus griseus, notes on eggs of, Ohio Sta. 292
Berry worm, notes on, N. J. Sta 134
Biology of hog cholera, U. S. D. A 104
silage, Ill. Sta 200
Birch, white, notes on, S. Dak. Sta 315
yellow, notes on, S. Dak. Sta 315
Blackberries, varieties, Mich. Sta 229
Ohio Sta 287
Tex. Sta 320
Black-headed borer, notes on, Iowa Sta 45
Black rot of grapes—
botanical description, Del. Sta 196
experiments on, Del. Sta 195, 196
notes on, Tex. Sta 319
treatment of, Ohio Sta 294
U. S. D. A 168, 170
Black walnut, notes on, Ala. College Sta. 1
Blight, grape leaf, notes on, Tex. Sta 319
pear leaf, treatment of, U. S. D. A. 170
strawberry leaf, notes on, N. Y. Cornell Sta 281
Blister beetle as locust parasite, Minn. Sta. 231
Blood, dried, as fertilizer for corn, Vt. Sta. 156
wheat, Va. Sta 158
Blue-grass, English, field experiments with, Nebr. Sta 121
Kentucky, effect of ripeness on crop, Ill. Sta 34
experiments with, Mass. State Sta 80
Texas, notes on, Fla. Sta 197

Page.

Blue-grass, Texas, notes on, La. State Sta 69
Bokhara clover, experiments with, Mass. State Sta 80
Bone-black, analyses of, Conn. State Sta 16
as fertilizer for corn, Ill. Sta 33
cost of phosphoric acid from, Conn. State Sta 16
for home-mixed manures, N. H. Sta 129
Bone, ground, amount used in Indiana, Ind. Sta 37
analyses of, Conn. State Sta 61
Mass. State Sta 80
N. J. Sta 259
as fertilizer for corn, Ill. Sta. 33
field experiments with, N. Y. Cornell Sta 283
Bone manures, analyses and valuation of, Conn. State Sta 17
Bordeaux mixture for—
apple scab, Ohio Sta 294
black rot of grapes, Del. Sta 195
Ohio Sta 294
brown rot of stone fruits, Ohio Sta 294
leaf blight, U. S. D. A 170
potato rot, Ohio Sta 291
U. S. D. A 169
quince-leaf spot, Ohio Sta 294
Borer in wheat, account of, N. Y. State Sta. 277
Botanical department, equipment of, Ind. Sta 36
notes, U. S. D. A 168
Botanist and entomologist of South Carolina Station, report of 146
Botany, cryptogamic, studies in, N. Y. Cornell Sta 283
Division of, Bulletin No. 8, U. S. D. A 168
studies in, N. Y. Cornell Sta 282
Box-elder, notes on, S. Dak. Sta 20, 315
Brachytarsus variegatus, enemy of smut in oats, Kan. Sta 216
Braconid fly, notes, Mich. Sta 226
Bran, in feeding experiments, Iowa Sta 210
Va. Sta 321
pig-feeding experiment, Kan. Sta 216
wheat, analyses, Ga. Sta 198
N. Y. Cornell Sta 136
in feeding experiments for beef, N. Y. State Sta 270
feeding experiments for milk, Mass. State Sta 77, 223
pig-feeding experiments, N. Y. Cornell Sta 135
Brazilian flour corn, trial of, Mich. Sta 89
Breeds, dairy test of, N. J. Sta 258
N. Y. State Sta 269
Vt. Sta 321
feeding test of, Mich. Sta 84
Brewers' grains, analyses of, Conn. State Sta 15
British Columbia, experimental farm of 245
Brown rot of stone fruits, treatment of, Ohio Sta 294
Bruchus pisi, remedy for, Mo. Sta 102

Page.

- *Bruchus pisi*, notes on, Colo. Sta 12
- Bryobia in dwellings, notes on, Ind. Sta 11
- *Buchloe dactyloides*, notes on, Tex. Sta 320
- Buckwheat middlings, analyses of, Conn. State Sta 15
  - varieties, Iowa Sta 212
- Buds, apple, investigation of, Iowa Sta 43
- Buffalo beetle, notes on, Mass. Hatch Sta 224
- Buildings of Alabama College Station 7
  - Nebraska Station 121
  - North Carolina Station 286
- Bulletins, station, received by Office of Experiment Stations 52, 113, 172, 241, 304
- Burdock, Wisconsin law concerning, Wis. Sta 323
- Butter, competitive exhibition, N. H. Sta 130
  - effects of different methods of setting milk, Ala. College Sta 184
    - heating milk, N. Y. Cornell Sta 135
  - making, action of bacteria, Conn. Storrs. Sta 193
    - in the South, Tex. Sta 151
    - sources of loss, W. Va. Sta 323
    - suggestions in, Tex. Sta 151
  - results of giving cows warm water in winter, Wis. Sta 324
  - value of first half and last half of milking compared, Ind. Sta 40
  - washing and salting, Minn. Sta 98
  - yield from cows of different breeds, N. Y. State Sta 268
- Buttermilk, treatment to avoid loss of butter fat, W. Va. Sta 323
- Butternut trees, notes on, S. Dak. Sta 20, 315
- Cabbage bug, harlequin, notes on, Ga. Sta 27
- Cabbage butterfly—
  - notes on, Ga. Sta 26
  - Southern, notes on, Colo. Sta 12
    - S. Dak. Sta 21
  - white, notes on, Del. Sta 22
- Cabbage caterpillar, European, notes on, Colo. Sta 11
  - plant-louse, notes on, S. Dak. Sta 21
  - plusia, notes on, S. Dak. Sta 21
  - worms, notes on, Iowa Sta 45
    - S. Dak. Sta 21
- Cabbages, heading as affected by transplanting, N. Y. Cornell Sta 283
  - seed from Puget Sound, Ohio Sta 294
  - varieties, Minn. Sta 94
    - Ohio Sta 293
- *Cacoecia semiferana*, notes on, Colo. Sta 12
- California, Agricultural Experiment Station of the University of 10, 189
  - physical, geographical and agricultural features of, Cal. Sta 10
  - Station bulletins 10, 189
  - University of 10, 189
- Calumet plantation, Pattersonville, La., sugar experiments at 236
- Calves, dehorning, Miss. Sta 233
  - entozoic diseases of, Miss. Sta 233
  - feeding experiment with, Mich. Sta 86
    - Miss. Sta 233
- Camaroon corn, trial of, Mich. Sta 89
- Canada, agricultural investigations in 245
- Canebrake (Alabama) Experiment Station 8, 187
- Canker worm, remedies for, Ohio Sta 138
- Carbohydrates in feeding stuffs, prices for, Del. Sta 197
- *Carpocapsa pomonella*, notes on, Colo. Sta 10, 11
  - Del. Sta 22
- Carrots, in feeding experiment with milch cows, Mass. State Sta 223
  - varieties, Mich. Sta 87
    - Nebr. Sta 254
- *Carya tomentosa*, analysis of, Ga. Sta 26
- *Castanea vulgaris*, analysis of, Ga. Sta 26
- Castor pomace, analyses and valuation of, Conn. State Sta 17
  - cost of nitrogen from, Conn. State Sta 16
- Cattle, corn stalk disease of, Nebr. Sta 121
  - dairy test of different breeds, N. Y. State Sta 269
  - dehorning, Miss. Sta 233
    - Tex. Sta 153
  - diseases in Nebraska, investigations of, Nebr. Sta 123
  - feeding, notes on, Del. Sta 196
    - R. I. Sta 296
    - on scientific principles, N. C. Sta 283
  - foods and feeding rations for, N. Y. State Sta 266
  - hydrophobia in, Nebr. Sta 125
  - lice, remedy for, Iowa Sta 45
  - method to determine age of, W. Va. Sta 161
  - plague, etiology and nature of, Nebr. Sta 124
  - range, care of, Tex. Sta 154
    - necessity of shelter, Tex. Sta 154
- Caucasian prickly comfrey, trial of, Mich. Sta 89
- Cauliflower seed, Puget Sound, merits of, Ohio Sta 294
  - varieties, Ohio Sta 293
- *Cecidomyia* (sp. ?), notes on, N. J. Sta 134
- Cecropia moth, notes on, Minn. Sta 232
  - S. Dak. Sta 21
- Cedar trees, notes on, S. Dak. Sta 20
- Central experimental farm of Canada 245
- *Cephus pygmaeus*, notes on, N. Y. Cornell Sta 277
- *Ceramica picta*, notes on, Colo. Sta 12
- Chaff, analyses, Mass. State Sta 80
- *Chaitophorus negundinis*, notes on, Nebr. Sta 120
- Charbon, symptoms and treatment, Miss. Sta 101
- *Chauliodes rastricornis*, notes on, Ohio Sta 292
- Cheese, manufacture in Texas, Tex. Sta 151
- Chemical laboratories, methods and record of work 58
- Chemistry, Division of, U. S. D. A 51, 111, 235, 240, 300, 303

Page.
Chemists, official agricultural, convention of, U. S. D. A 237
Cherries, protection from plum curculio, Ohio Sta 290
varieties, Mich. Sta 229
Cherry, black wild, notes on, S. Dak. Sta 315
tree slug, notes on, Ohio Sta 291
trees, notes on, S. Dak. Sta 20
Chestnut trees, experiments with, Mich. Sta 229
notes on, Ala. College Sta 4
S. Dak. Sta 20
wood, analysis of, Ga. Sta 26
Chinch-bug, false, notes on, Colo. Sta 10, 12
Chloride of lime for cotton root rot, Tex. Sta 318
Chloris verticillata, notes on, Tex. Sta 320
Cholera, hog, description and treatment of, N. C. Sta 312
history, nature, and treatment, U. S. D. A 103
Chrysanthemum leaf blight, remedy for, Mass. Hatch Sta 83
Chrysanthemums, cross-fertilization of, Ind. Sta 36
Chrysopa fly, notes on, Mich. Sta 226
Churning, method at West Virginia Station, W. Va. Sta 323
Churns, test of, N. H. Sta 130
Cimbex americana, notes on, Minn. Sta 232
Nebr. Sta 120
Cirsium arvense, Wisconsin law concerning, Wis. Sta 323
Cladosporium carpophilum, notes on, Ind. Sta 36
cucumerinum, notes on, Ind. Sta 36
viticolum, notes on, Tex Sta 319
Click beetle, as a locust parasite, Minn. Sta 231
Climate, effect upon crop production, Ind. Sta 39
Clisiocampa americana, notes on, N. Y. Cornell Sta 283
Clover, acquisition of nitrogen from air by, Conn. Storrs Sta 194
analyses of, Ill. Sta 34
Vt. Sta 157
burr, field experiments with, Nebr. Sta 122
crimson, notes on, Fla. Sta 197
digestibility of, Ill. Sta 35
effect of ripeness on crop, Ill. Sta 34
experiments in ensiling, Minn. Sta 229
field experiments with, Nebr. Sta 121
for sandy soils, Mich. Sta 228
for stock feeding, Del. Sta 196
in feeding experiments for beef, N. Y. State Sta 270
insects, partial bibliography of, Ohio Sta 292
Japan, adaptability to Alabama, Ala. College Sta 183
field experiments with, Nebr. Sta 122
loss of water in curing, Ill. Sta 34
Page.
Clover, red, field experiment with, Nebr. Sta. 254
root borer, remedies for, Ohio Sta 138
roots and stubble, Conn. Storrs Sta 18
seed impurities, notes on, Nebr. Sta 254
midge, remedies for, Ohio Sta 138
vitality of, Del. Sta 25
stem borer as a gall maker, Ind. Sta 41
sweet, field experiments with, Nebr. Sta 122
varieties, La. State Sta 69
white, field experiments with, Nebr. Sta 122
Coal, analyses of, Ala. College Sta 4
bituminous, analyses of, La. State Sta 221
dust, analyses of, Mass. State Sta 80
Cockle bur, Wisconsin law concerning, Wis. Sta 323
Codling moth, notes on, Colo. Sta 10, 11
Del. Sta 22
treatment with London purple, Oreg. Sta 294
Co-efficient of digestion, explanation of, Ill. Sta 34
Colic of horses, treatise on, Ohio Sta 139
Colleges, new, facts relating to 248
Collops nigriceps, notes on, Colo. Sta 13
Colorado Agricultural Experiment Station 10, 190
potato beetle, notes on—
Del. Sta 22
Ohio Sta 138
S. Dak. Sta 21
State Agricultural College of 10, 190
Station bulletins 10, 190
Comfrey, prickly, test of, Mich. Sta 89
Pa. Sta 143
Congress, International Agricultural, at Vienna 246
Connecticut—
Agricultural Experiment Station 14, 191
State Station bulletins 14, 191
Storrs Agricultural Experiment Station 18, 192
Storrs Agricultural School 18, 192
Storrs Agricultural Experiment Station bulletins 18, 192
Conotrachelus leucophaetus, notes on, Colo. Sta 13
nenuphar, experiments in rearing, Ind. Sta 41
notes on, Del. Sta 22
remedies for, Ohio Sta 290
Convention of American Agricultural Colleges and Experiment Stations, third annual 57
Copper sulphate for apple powdery mildew, U. S. D. A 170
black rot of grapes, Del. Sta 195
Copperas, effect on corn, Ky. Sta 62
Coreus tristis, notes on, Colo. Sta 10, 11
Corn-and-cob meal in feeding experiments—
Iowa Sta 210
Mass. State Sta 77
Tex. Sta 153

Page.
Corn, bacterial disease of, Ill. Sta 199
best time for cutting, Kan. Sta 47
Brazilian flour, trial of, Mich Sta 89
Pa. Sta 143
Camaroon, trial of, Mich. Sta 89
chicken, analyses of, Miss. Sta 233
composition of, effect of fertilizers on, Vt. Sta 156
cross-fertilization of, Minn. Sta 97
cultivation of, Ill. Sta 31, 32
Ind. Sta 38
Minn. Sta 92
S. Dak. Sta 18
cultivators and plows, use of, Ind. Sta 39
culture for dry seasons, Ind. Sta 39
early maturing varieties, Ill. Sta 28
effects of pulling off leaves for fodder, North La. Sta 72
feeding experiments with, Iowa Sta 210
Mich. Sta 85
Tex. Sta 153
Va. Sta 321
fertilizers in relation to shrinkage of, Ky. Sta 62
field experiments with—
Ala. Canebrake Sta 8
Ala. College Sta 3
Fla. Sta 198
Ill. Sta 28, 32
Ind. Sta 37
Iowa Sta 211
Ky. Sta 61
La. State Sta 70
Md. Sta 75
Mass. State Sta 80
Minn. Sta 93
Mo. Sta 102
Nebr. Sta 254
N. J. Sta 132
N. C. Sta 281
North La. Sta 72
S. Dak. Sta 18
Vt. Sta 156
fodder, analyses of, Conn. State Sta 15
Ill. Sta 29
N. Y. Cornell Sta 136
N. Y. State Sta 267
digestion experiment with, Pa. Sta 296
feeding experiments with—
Iowa Sta 210
Kan. Sta 46
Mass. State Sta 77, 222
N. Y. State Sta 270
Mich. Sta 88
loss in making, Kan. Sta 46
objections to, in Kansas, Kan. Sta 46
storage of, Mo. Sta 249
time for cutting, Kan. Sta 17
waste in feeding, Kan. Sta 46
germ, analyses of, N. Y. Cornell Sta 282
germination test, N. Y. Cornell Sta 272
Pa. Sta 295
habits of root growth, Minn Sta 91

Page.
Corn, improvement by cross-fertilization and selection, Minn. Sta 97
Kaffir, analysis of, Pa. Sta 143
test of, Mich. Sta 89
Nebr. Sta 122
Pa. Sta 143
late maturing varieties, Ill. Sta 28
manurial requirements, North La. Sta 72
meal, analysis of, N. H. Sta 255
damaged, analyses and valuation of, Conn. State Sta 17
in feeding experiments—
Kan. Sta 216
Mass. State Sta 77, 223
N. Y. State Sta 270
Va. Sta 321
medium maturing varieties, Ill. Sta 28
Mercer flint, notes on, Minn. Sta 93
mule feeding experiments with, Miss. Sta 233
pig feeding experiments with—
Ala. College Sta 7
Kan. Sta 216
Ky. Sta 63
N. Y. Cornell Sta 135
plant, analyses at different stages of growth, Mo. Sta 251
branching of, Minn. Sta 93
investigations of, N. Y. State Sta 265
notes on, N. C. Sta 286
planting at different dates—
Ill. Sta 29
Ind. Sta 38
North La. Sta 72
planting at different depths, Ill. Sta 30
planting at different distances—
Ill. Sta 30
Ind. Sta 38
North La. Sta 72
Wis. Sta 166
planting in hills *vs.* drills, Ill. Sta 31
pop, varieties, Nebr. Sta 254
root growth of, Ill. Sta 32
root-pruning of, Ill. Sta 31
and hilling, Minn. Sta 92
root worm, notes on, Iowa Sta 44, 45
Nebr. Sta 120
silage, analyses of, Miss Sta 233
N. Y. State Sta 265
feeding experiments with, Mass. State Sta 77, 223
planting and harvesting, N. Y. State Sta 265
time to harvest, Minn. Sta 97
N. Y. State Sta 266
Wis. Sta 166
varieties, Ill. Sta 29
Mich. Sta 88
Minn. Sta 95
N. Y. State Sta 265
Ohio Sta 140
Pa. Sta 143
Wis. Sta 165
smut of, Nebr. Sta 253
stalk disease in cattle, Nebr. Sta 124

Page.

Corn-stalks, chemical composition, Mich. Sta 90
for cattle feeding, Del. Sta 196
stover in feeding experiments, Mass. State Sta 77, 223
study of life history of, Mo. Sta 251
sweet, garden experiments with, Ill. Sta 33
varieties, Ill. Sta 33
Ind. Sta 35
Iowa Sta 212
Nebr. Sta 254
varieties, Ill. Sta 28
Ind. Sta 39
Iowa Sta 212
La. State Sta 69
Nebr. Sta 122, 254
North La. Sta 72
Pa. Sta 143
worm, notes on, Oreg. Sta 295
Cornell (N. Y.) Experiment Station 134, 271
Station bulletins 134, 271
Cornus florida, analysis of, Ga. Sta 26
Cosmopepla carnifex, notes on, Ind. Sta 41
Cotton—
conditions required for finer grades of, S. C. Sta 314
fertilizer, formulas for, La. State Sta 70
field experiments with—
Ala. Canebrake Sta 187
Ala. College Sta 5
Ga. Sta 26
N. C. Sta 284
North La. Sta 71
hull ashes, analyses, Conn. State Sta 15
Mass. State Sta 80
N. Y. Cornell Sta .. 282
cost of potash from, Conn. State Sta 16
field experiments with, Ala. College Sta 3
plant, development of, S. C. Sta 313
relation of temperature and moisture to, S. C. Sta 312
planting at different distances, North La. Sta 72
root rot, account of, Tex. Sta 318
roots, development of, S. C. Sta 314
rust, inquiry regarding, N. C. Sta 138
sea island, where produced, S. C. Sta .. 314
seed, as feed for calves, Miss. Sta 233
fertilizer, Ala. College Sta 3, 184
boiled, in feeding experiment for beef, Tex. Sta 153
bran, analyses, Conn. State Sta 15
hulls, analyses, Ark. Sta 9
N.Y. Cornell Sta. 136, 282
Tenn. Sta 315
as feeding stuff, Tenn. Sta .. 315
feeding experiments with, Ark. Sta 9
varieties, Ala. College Sta 7
La. State Sta 70
Nebr. State Sta 123
North La. Sta 72

Page.

Cotton-seed meal—
analyses of, Conn. State Sta 15
Ga. Sta 198
Mass. State Sta 80
N. H. Sta 255
N. Y. Cornell Sta 136
Tenn. Sta 149, 315
as feeding stuff, Tenn. Sta 315
fertilizer in Louisiana, La. State Sta. 221
for oats, Ala. Canebrake Sta. 187
Ark. Sta 189
potatoes, Ala. Canebrake Sta 188
wheat, Ark. Sta 189
cost of nitrogen from, Conn. State Sta .. 16
field experiments with, Ala. College Sta. 3, 6
La. Sugar Sta ... 68
N.Y. Cornell Sta. 283
N. C. Sta 285
S. C. Sta 147
in feeding experiment, N.Y. Cornell Sta. 135
Tex. Sta 153
Va. Sta 321
trade value of, Tenn. Sta 149
Cottonwood beetle, notes on, Colo. Sta 12
trees, notes on, Nebr. Sta 253
S. Dak. Sta ... 20, 315
Cow-pea as a fertilizing crop, Ga. Sta 27
vines, analysis of, Ga. Sta 198
Cow-peas, feeding experiments with, Mass. State Sta 77
field experiments with, Nebr. Sta 222, 254
varieties, Md. Sta 75
Pa. Sta 143
Cows at pasture, effect of grain ration for, N. Y. Cornell Sta 280
feeding experiment with, Tex. Sta ... 152
milch, competitive test of, Vt. Sta 321
escutcheon of, W. Va. Sta 161
feeding experiments with—
Ala. College Sta 7
Mass. State Sta 77, 222
Minn. Sta 96
N. H. Sta 255
N. Y. State Sta 269
Ohio Sta 111
of Iowa, N. Y. State Sta 269
of New York, N.Y. State Sta. 268, 269
rations used in New York State for, N. Y. State Sta 267
selection of, W. Va. Sta 161
test of different breeds—
N. J. Sta 258, 260
N. Y. State Sta 269
Vt. Sta 321
variation in, Mass. State Sta .. 78
W. Va. Sta 323
warm *vs.* cold water for, Ind. Sta 40
Wis. Sta 324
milk mirror of, W. Va. Sta 161
spaying of, Ark. Sta 8
Crambus exsiccatus, account of, Iowa Sta 45
Cranberry, fungous diseases of, N. J. Sta 263
gall fungus, notes on, N. J. Sta .. 263

Page.

Cranberry insects, notes on, N. J. Sta. 131
moth, glistening, N. J. Sta. 134
scald, inquiry concerning, N. J. Sta. 264
notes on, N. J. Sta. 263
span-worm, notes on, N. J. Sta. 131
tip-worm, notes on, N. J. Sta. 134
vines, analysis, Mass. State Sta. 80
worm, red-striped, notes on, N. J. Sta. 131
Cream, basis of price at Vermont creameries, Vt. Sta. 320
conditions affecting separation of, Wis. Sta. 161
cost of feed per quart produced, Mass. State Sta. 81
effect of bacteria on ripening of, Conn. Storrs Sta. 193
fertilizing value of constituents of, Mass. State Sta. 81
growth of bacteria in, Conn. Storrs Sta. 193
raising, test of systems of setting milk, N. H. Sta. 130
separators, use of, in the South, Tex. Sta. 151
Creameries for Texas, Tex. Sta. 151
testing of milk of, Vt. Sta. 320
Creamery industry, adaptability to West Virginia, W. Va. Sta. 160
plans for, Tex. Sta. 151
record for 1887 and 1888 at Mass. State Sta. 81
six months' experience with, W. Va. Sta. 322
Creaming experiment, Ala. College Sta. 184
W. Va. Sta. 322
Crepidodera cucumeris, notes on, Ind. Sta. 41
Cricket, snowy tree, remedies for, Ohio Sta. 138
Crioceris asparagi, notes on, Del. Sta. 22
Cross-fertilization of chrysanthemums, Ind. Sta. 36
corn, Minn. Sta. 97
squashes, Mich. Sta. 89
Cryptochetum iceryæ, as an enemy of fluted scale, U. S. D. A. 301
Cryptohypnus bicolor, var. *lacustris*, Minn. Sta. 231
Cucumber beetle, remedies for, Ohio Sta. 290
striped, notes on, Iowa Sta. 45
Cucumbers, experiments in raising, Fla. Sta. 198
spotting of, Ind. Sta. 36
varieties, Nebr. Sta. 122, 254
Cucurbits, tests of seeds of, N. Y. Cornell Sta. 283
Cultivators, corn, tests of, Ind. Sta. 38
Curculio, plum, experiments with, Ind. Sta. 41
insecticides for, Mich. Sta. 227
notes on, Iowa Sta. 45
remedies for, Ohio Sta. 138, 290
sagittaria, notes on, Ohio Sta. 292
Currant borer, notes on, Colo. Sta. 10, 12
measuring worm, notes on, Colo. Sta. 11

Page.

Currant worm, notes on, Ohio Sta. 291
remedies for, Ohio Sta. 138
Currants, anthracnose of, notes on, N. Y. Cornell Sta. 283
Crandall, notes on, N. Y. Cornell Sta. 283
varieties, Mich. Sta. 229
Cuscuta trifolii, notes on, Colo. Sta. 190
Del. Sta. 24
Cut-worms, notes on, Iowa Sta. 45
Nebr. Sta. 120
S. Dak. Sta. 21
Cymatophora pampinaria, notes on, N. J. Sta. 131
Cynipidæ, new species, notes on, Iowa Sta. 213
Cynodon dactylon, adaptability to Alabama, Ala. College Sta. 183
Cynoglossum officinale as a host of wheat rust, Ind. Sta. 205
Dactylis glomerata, notes on, Tenn. Sta. 317
Tex. Sta. 320
Dairy apparatus, test of, N. H. Sta. 130
description of, Ala. College Sta. 7
N. C. Sta. 286
products, analysis of, Ala. College Sta. 7
record for 1887 and 1888, at Mass. State Sta. 81
Dairying at Ontario experimental farm. 246
Daisy, white or ox-eye, Wisconsin law concerning, Wis. Sta. 323
Danthonia compressa, notes on, Tenn. Sta. 317
spicata, notes on, Tenn. Sta. 317
Deer parks, grasses of, Tenn. Sta. 316
Dehorning, methods and results of, Miss. Sta. 233
of cattle, Tex. Sta. 153
Delaware College 22, 195
Experiment Station 22, 195
Station bulletins 22, 195
Dermestes lardarius, Mass. Hatch Sta. 224
Desk, recording, new form of, Iowa Sta. 211
Des Lignes sugar experiment station, experiments at, U. S. D. A. 235
Devon cows, dairy test of, Vt. Sta. 321
steers, feeding test of, Mich. Sta. 84
Dhoura, field experiments with, Nebr. Sta. 254
Diabrotica longicornis, notes on, Iowa Sta. 44
Nebr. Sta. 120
vittata, notes on, Del. Sta. 22
remedies for, Ohio Sta. 290
Diffusion of sugar-cane juice, La. Sugar Sta. 73
U. S. D. A. 235
Digest of annual reports of stations for 1888 1
Digestibility of feeding stuffs, N. C. Sta. 284
grasses and clovers, Ill. Sta. 35
orchard grass and timothy compared, Ill. Sta. 35
Digestion, co-efficient of, Ill. Sta. 34
co-efficients, tables of, R. I. Sta. 296
experiments with corn fodder and silage, Pa. Sta. 296
Diseases of cattle in Nebraska, investigations of, Nebr. Sta. 123
Dock, sour and yellow, Wisconsin law concerning, Wis. Sta. 324

Page.

- Dodder, account of, Colo. Sta 190
  - Del. Sta 24
- Dogwood, analysis of, Ga. Sta 26
- *Donacia subtilis*, notes on, Ohio Sta 292
- *Doryphora decemlineata*, notes on, Del. Sta 22
- Drainage experiments, Ala. Canebrake Sta 187
  - for alkali lands, Cal. Sta 189
    - sugar-cane land, La. Sugar Sta 67
  - relation of rainfall to, Ala. Canebrake Sta 8
  - tile, Ala. Canebrake Sta 8
- Eau celeste, for black rot of grapes, Del. Sta 196
- *Eburia quadrigeminata*, notes on, Ind. Sta 41
- Economic Ornithology and Mammalogy, Division of, U. S. D. A 51, 60, 108, 112
- Editorial notes 57, 117, 175, 245, 309
- Egg-plants, varieties, Nebr. Sta 123
- Eight-spotted forester, notes on, Colo. Sta 11
- *Elateridæ* spp., account of, Iowa. Sta 45
- *Eleusine indica*, adaptability to Alabama, Ala. College Sta 138
- Elm aphis, notes on, Colo. Sta 12
  - leaf caterpillar, notes on, Colo. Sta 12
  - saw-fly, notes on, S. Dak. Sta 21
  - trees, notes on, S. Dak. Sta 20, 315
- Ensilage. (See Silage.)
- Entomological suggestions and inquiries, N. J. Sta 134
- Entomologist and botanist of South Carolina Station, report of 146
- Entomologists, Association of Official Economic, meeting of 60
- Entomology, Division of, U. S. D. A 240, 301, 303
- *Entomosporium maculatum*, notes on, N. Y. Cornell Sta 283
- Entozoic diseases of sheep and calves, Miss. Sta 233
- Epizoötic diseases among swine, U. S. D. A. 107
- *Erax bastardii*, as a locust parasite, Minn. Sta 231
- Ergot, prevalence of, U. S. D. A 170
- *Erysiphe* (*Sphærotheca*) *pannosa*, remedy for, Mass. Hatch Sta 83
- *Erysipheæ* of Montana, notes on, U. S. D. A 170
  - on *phytoptus* distortions, notes on, U. S. D. A 170
- *Erythroneura* spp., notes on, Colo. Sta 13
- *Euchlæna luxurians*, trial of, Mich. Sta 89
- *Eudamus tityrus*, notes on, Colo. Sta 10
- *Eudioptis hyalinata*, notes on, Ga. Sta 27
  - *nitidalis*, notes on, Ga. Sta 27
- *Eufitchia ribearia*, notes on, Colo. Sta 11
- European cabbage caterpillar, notes on, Colo. Sta 11
- *Eurycreon rantalis*, notes on, Colo. Sta 10, 12
- Evergreen trees, notes on, S. Dak. Sta 20, 315
- Evergreens, varieties, S. Dak. Sta 315
- Fairs, relation to colleges and stations 58
- Fall web-worm, notes on, Minn. Sta 232
- Farm, experimental, of Ontario 246
  - of Nebraska Station, account of 121
    - Rhode Island Station, account of 146
  - practice, questions relating to, N. J. Sta 264

Page.

- Farmers' institutes, relation to colleges and stations 58
- Fat globules of milk, Ind. Sta 40
- Fauna, North American, Nos. 1 and 2, U. S. D. A 109
- Feeding experiments—
  - alfalfa in, Colo. Sta 190
  - at Ontario experimental farm 246
  - corn fodder in, Kan. Sta 46
  - cotton-seed hulls in, Ark. Sta 9
  - financial record of, Mass. State Sta 78
  - for lean pork, N. Y. Cornell Sta 134
    - milk, Ala. College Sta 7
      - Mass. State Sta 17, 222
      - Minn. Sta 96
      - Mo. Sta 250
      - N. H. Sta 255
      - N. Y. State Sta 269, 280
      - Ohio Sta 141
  - with calves, Mich. Sta 86
    - Miss. Sta 233
    - cows at pasture, N. Y. Cornell Sta. 280
    - heifers, Ark. Sta 9
    - lambs, N. Y. Cornell Sta 273
    - pigs, Ala. College Sta 7
      - Kan. Sta 216
      - Ky. Sta 63
      - N. Y. Cornell Sta 134
    - steers, Ark. Sta 9
      - Iowa Sta 210
      - Mich. Sta 84
      - Mo. Sta 250
      - Tex. Sta 152
      - Va. Sta 321
- Feeding for beef, profit in, Tex. Sta 154
  - grain to cows at pasture, N. Y. Cornell Sta 280
  - of animals in North Carolina, N. C. Sta 285
    - notes on, R. I. Sta 296
    - on scientific principles, N. C. Sta 283
  - cattle, notes on, Del. Sta 196
  - rations used in New York State—
    - editorial notes on 247
    - statistics of, N. Y. State Sta 267
  - standards, tables of, N. Y. State Sta 267
    - N. C. Sta 284
    - R. I. Sta 296
  - stuffs, analyses of, Ala. College Sta. 7
    - Conn. State Sta. 15
    - Del. Sta 197
    - Mass. State Sta. 77
    - N. Y. Cornell Sta 136
    - N. Y. State Sta 267
    - Tex. Sta 153
    - chemical control of, Del. Sta 196
    - chemistry of, N. C. Sta 284
    - comparative cost of different combinations, Mass. State Sta 222
    - composition of, R. I. Sta 296
    - cotton-seed hulls and meal, Tenn. Sta 315

Page.

Feeding stuffs, Delaware prices of, Del. Sta. 197
determination of water in, N. Y. Cornell Sta 135
digestibility of, N. Y. State Sta 267
explanation of technical terms—
Del. Sta 196
N. C. Sta 281
fertilizing values of, R. I. Sta 296
fodder analyses, Mass. State Sta 79
grain *vs.* corn ration, Mich. Sta 85
inspection of, Del. Sta ...22, 23, 196
Japanese, composition and digestibility of 247
manurial value of, N. Y. Cornell Sta 275
method of estimating fuel value of 269
methods of valuation, Conn. State Sta 15
needed investigation of 248
value of fertilizing constituents, Mass. State Sta 77
Fertilizers. (See also Manure, Bone, Superphosphates, etc.)—
analyses of, Ala. College Sta 4, 7, 184
Ark. Sta 9
Conn. State Sta 15, 16, 17, 191
Fla. Sta 25
Ind. Sta 37
Ky. Sta 218
La. State Sta 69, 221
Me. Sta 73
Mass. State Sta 80, 82
Mich. Sta 226
N. J. Sta 256, 258, 259
N. C. Sta 136, 138
Pa. Sta 145
Tenn. Sta 149, 317
Vt. Sta 155
and fertilizing materials—
explanations of, N. H. Sta 127
notes on, Tenn. Sta 148
as related to corn shrinkage, Ky. Sta 62
commercial, variation in effects of, Ind. Sta 40
vs. farm manures, N. H. Sta 128
home-mixed, N. H. Sta 127
stable-manure, Ind. Sta 39
cost of ingredients of, Conn. State Sta. 16
duties of dealers in, Conn. State Sta 15
effect on composition of corn, Ky. Sta. 62
Vt. Sta. 156
shrinkage of corn, Ky. Sta 62
field experiments with—
Ala. Canebrake Sta 5, 187
Ala. College Sta 3
Ark. Sta 188
Fla. Sta 198
Ga. Sta 27
Ill. Sta 32

Page.

Fertilizers—
field experiments with—
Ind. Sta 35
Japan 247
Kan. Sta 211
Ky. Sta 61, 62, 218, 219
La. State Sta 70
La. Sugar Sta 65
Md. Sta 76
Mich. Sta 87
N. H. Sta 127
N. J. Sta 131, 261
N. Y. Cornell Sta 283
N. C. Sta 281
North La. Sta 71
Ohio Sta 288
S. C. Sta 147
Va. Sta 158
home-mixed, advantage of, Conn. State Sta 16
analyses of, Conn. State Sta 16
formulas for, La. State Sta 70
N. H. Sta 129
inspection of, Fla. Sta 25
Mass. State Sta 80
N. J. Sta 256
N. C. Sta 136
Pa. Sta 145
Japanese, valuations and composition of 247
law regarding, in Alabama, Ala. College Sta 184
Arkansas, Ark. Sta 9
Indiana, Ind. Sta 37
Kentucky, Ky. Sta 218
Louisiana, La. State Sta 221
Massachusetts, Mass. State Sta 79
Michigan, Mich. Sta 226
North Carolina, N. C. Sta 137
Pennsylvania, Pa. Sta. 145
Tennessee, Tenn. Sta. 149
roots of plants as, Conn. Storrs Sta 18
sampling of, Ark. Sta 9
Mass. State Sta 79
statistics for Indiana, Ind. Sta 37
Vermont in 1888, Vt. Sta 156
valuation of, Ala. College Sta 184
Ark. Sta 9
Conn. State Sta 17, 191
Ky. Sta 218
Mass. State Sta 80
N. J. Sta 257
Pa. Sta 145
Vt. Sta 155
Fertilizing constituents of feeding stuffs, Mass. State Sta 77
Fescue, hard, field experiments with, Nebr. Sta 121
meadow, effect of ripeness on crop, Ill. Sta 34
field experiments with, Nebr. Sta 254

Page.

- Fescue, red, field experiments with, Nebr. Sta 121
  - sheep, field experiments with, Nebr. Sta 121, 254
  - tall, field experiments with, Nebr. Sta 121
- *Festuca elatior*, notes on, Tex. Sta 320
- Fibers, textile, importation of, U. S. D. A 57, 299
  - investigations of, U. S. D. A 57, 299
  - machinery for, U. S. D. A 57, 299
- Fibrin of milk, Wis. Sta 162
- Field experiments—
  - co-operative, in Ontario 246
    - with fertilizers, N. C. Sta 284
  - in cutting corn and fodder, Kan. Sta 47
  - methods of planting, Mass. State Sta 80
- Field experiments with—
  - alfalfa, Nebr. Sta 122
  - barley, Mass. State Sta 80
    - S. Dak. Sta 19
  - clovers, Nebr. Sta 121
  - corn, Ala. Canebrake Sta 8
    - Ala. College Sta 3
    - Ill. Sta 28
    - Ind. Sta 37
    - Iowa Sta 211
    - Md. Sta 75
    - Mass. State Sta 80
    - Minn. Sta 91
    - Mo. Sta 102
    - Nebr. Sta 254
    - North La. Sta 72
    - S. Dak Sta 18
  - cotton, Ala. Canebrake Sta 187
    - Ala. College Sta 5
  - cow-peas, Nebr. Sta 122
  - fertilizers, Ala. Canebrake Sta 8, 187
    - Ala. College Sta 3, 6
    - Ark. Sta 188
    - Fla. Sta 198
    - Ind. Sta 35, 39
    - Ky. Sta 61, 218, 219
    - La. State Sta 220
    - Md. Sta 75, 76
    - Mass. State Sta 80
    - N. H. Sta 127
    - N. J. Sta 261
    - N. Y. Cornell Sta 283
    - North La, Sta 71
    - Ohio Sta 288
    - S. C. Sta 148
    - Vt. Sta 156
    - Va. Sta 158
  - forage plants, Mass. State Sta 80
    - Nebr. Sta 121, 254
  - grasses, Mass. State Sta 80
    - Nebr. Sta 121, 254
  - hemp, Ky. Sta 62
  - millet, Nebr. Sta 122
  - oats, Ill. Sta 202
    - Md. Sta 75
    - Mass. State Sta 80
    - S. C. Sta 146
    - S. Dak. Sta 19
  - pea-nuts, Ala. College Sta 3

Page.

- Field experiments with—
  - peas, Nebr. Sta 122
  - potatoes, Ala. Canebrake Sta 188
    - Ind. Sta 35
    - Mass. State Sta 80
    - Minn. Sta 94
  - rice, in Japan 247
  - sugar-cane, Iowa Sta 44
    - La. Sugar Sta 63
  - sweet potatoes, Ala. College Sta 3
  - turnips, Ala. College Sta 3
  - vegetables, Japanese, Ind. Sta 36
  - wheat, Ind. Sta 206
    - Kan. Sta 214
    - Ohio Sta 287
    - S. C. Sta 146
    - S. Dak. Sta 19
- Fir trees, notes on, S. Dak. Sta 20
- Fire worm, notes on, N. J. Sta 134
- Fish, dried, analyses of, N. J. Sta 260
  - fly, toothed-horned, notes on, Ohio Sta 292
- Flax culture, report on, U. S. D. A 57, 299
  - seed, value for feeding and manure, Minn. Sta 230
- Flesh flies as locust parasites, Minn. Sta 232
- Floats, as a fertilizer for oats, Ark. Sta 189
  - field experiments with—
    - Ala. College Sta 6
    - Ga. Sta 26
- Floriculture, experiments in, Ind. Sta 36
- Florida Agricultural and Mechanical College 25, 197
  - Experiment Station 25, 197
  - Station bulletins 25, 197
- Fluted scale, report on enemies of, U. S. D. A 301
- Fodders. (See Feeding stuffs.)
- Foliage, injured by arsenites, Mich. Sta 227
- Food adulterations, account of, U. S. D. A 237
- Forage garden of Maryland Station 76
  - plants, field experiments with, Nebr. Sta 121
    - germination tests of, Pa. Sta 295
    - notes on, Ala. College Sta 183
      - North La. Sta 72
    - tests of seeds of, Del. Sta 23
    - trial of, Mich. Sta 89
    - varieties, La. State Sta 69
      - Pa. Sta 142
- Forest tent caterpillar, notes on, Colo. Sta 12
  - tree insects, notes on, Colo. Sta 12
- Forestry, division of, U. S. D. A 108
  - experiments in, S. Dak. Sta 20, 315
- Forests of the United States, relation to railways, U. S. D. A 119
- *Fraxinus americana*, analysis of, Ga. Sta 26
- Frost, effects on wheat, Minn. Sta 99
- Fruit worm, notes on, N. J. Sta 134
- Fruits. (See Horticulture.)
- Fungi in Lancaster County, Nebr., notes on, Nebr. Sta 253
  - nature and action of, Nebr. Sta 252
  - new, notes on, U. S. D. A 169
  - of cotton root rot, Tex. Sta 318
    - Missouri, U. S. D. A 168

Page.

- Fungi of peaches and cucumbers, Ind. Sta. 36
  - wheat rust, Ind. Sta 204
    - Minn. Sta 94
- Fungicides and insecticides, combining of, Ohio Sta 291
  - for black rot of grapes, Del. Sta. 195
    - cotton root rot, Tex. Sta. 319
    - smut in oats, Kan. Sta 216
- Fungous diseases of—
  - cranberries, N. J. Sta 263
  - plants, notes on, Conn. State Sta 15
    - Mass. Hatch Sta 225
- Garden experiments with sweet corn, Ill. Sta 33
  - (forage) of Maryland Station 76
  - of Louisiana State Station 69
    - Nebraska Station 121
  - web worm, notes on, Colo. Sta 12
- Gas lime, field experiments with, Ind. Sta. 39
- Geology of soils, Ga. Sta 26
- Georgia—
  - Agricultural Experiment Station 26, 198
  - Experiment Station, organization of 198
  - State College of Agriculture and Mechanic Arts of University of 26, 198
  - Station bulletins 26, 198
- German agricultural experiment stations, statistics of 175
- Germination of frosted grain, S. Dak. Sta. 19
  - tests, Del. Sta 25
    - Md. Sta 76
    - Mo. Sta 102
    - N. C. Sta 127, 136
    - Pa. Sta 295
- Glen Cove starch feed, analyses of, Conn. State Sta 15
- *Glœosporium nervisequum*, notes on, U. S. D. A 169
  - *ribis*, notes on, N. Y. Cornell Sta 283
- Gluten, analyses of, N. H. Sta 255
  - in feeding experiments for milk, N. H. Sta 255
  - meal, analyses of, Conn. State Sta. 15
    - La. State Sta 221
    - in feeding experiments, Mass. State Sta 77, 223
  - No. 1 feed, analyses of, Conn. State Sta 15
- Gooseberries, injuries to, by currant measuring worm, Colo. Sta 11
  - varieties, Mich. Sta 229
    - Ohio Sta 287
- Gooseberry mildew, treatment of, U. S. D. A. 169
  - saw-fly, notes on, Del. Sta 22
- Grain plant louse, notes on, Ind. Sta 41
  - Ky. Sta 219
  - Mich. Sta 91
  - Ohio Sta 291
  - *vs.* corn for beef cattle, Mich. Sta 85
- Grama, field experiments with, Nebr. Sta. 121
- Grapes, black rot of, Del. Sta 195
  - Ohio Sta 294
  - U. S. D. A 168, 170
  - cultivation of, Ala. Canebrake Sta. 188
- Grapes, cultivation of, Ala. College Sta 5
  - fungous diseases of, Tex. Sta 319
  - mildew of, Mass. Hatch Sta 83
    - U. S. D. A 170
  - paper bags as a protection for, Ala. College Sta 4
  - varieties, Ala. Canebrake Sta 188
    - Ala. College Sta 4
    - Iowa Sta 213
    - Mich. Sta 229
    - Tex. Sta 319
    - Va. Sta 321
- Grape-vine diseases, account of, U. S. D. A. 170
- Grape-vines, prevention of root-killing, Iowa Sta 213
- *Grapta interrogationis*, notes on, Colo. Sta. 12
  - *progne*, notes on, Colo. Sta 12
  - spp., notes on, Colo. Sta 10
- *Graptodera foliacea*, notes on, Colo. Sta 11
  - Nebr. Sta 120
- Grass, analyses of, Ala. College Sta 183
  - Ill. Sta 34
  - Bermuda, adaptability to Alabama, Ala. College Sta 183
  - blue stem, notes on, U. S. D. A 168
  - buffalo, notes on, Tex. Sta 320
  - crow foot or crab, adaptability to Alabama, Ala. College Sta 183
  - English blue, field experiments with, Nebr. Sta 121
    - perennial rye, field experiment with, Nebr. Sta 254
  - experiment stations, notes on 168
  - fescue, effect of ripeness on crop, Ill. Sta 34
    - field experiments with, Nebr. Sta 121
  - fowl meadow, notes on, N. Y. Cornell Sta 282
  - herd's, notes on, Tenn. Sta 317
  - Hungarian, in feeding experiments for beef, N. Y. State Sta 270
  - Johnson, field experiments with, Nebr. Sta 121, 254
  - Kentucky blue—
    - effect of ripeness on crop, Ill. Sta. 34
    - field experiments with, Nebr. Sta. 254
    - notes on, N. Y. Cornell Sta 282
  - lands, directions for manuring, Ala. College Sta 183
  - meadow foxtail, field experiments with, Nebr. Sta 121
    - oat, adaptability to Alabama, Ala. College Sta 183
  - mountain oat, notes on, Tenn. Sta 317
  - orchard, effect of ripeness on crop, Ill. Sta 34
    - field experiments with, Nebr. Sta 254
    - for pastures, Ill. Sta 35
    - notes on, Tenn. Sta 317
      - Tex. Sta 320
  - perennial rye, field experiments with, Nebr. Sta 121
  - porcupine, notes on, U. S. D. A 168

Page.

- Grass, prolific panic or sprouting crab, adaptability to Alabama, Ala. College Sta. 183
  - redtop, field experiments with, Nebr. Sta ... 121, 254
  - rescue, field experiments with, Nebr. Sta ... 254
  - roots and stubble of, Conn. Storrs Sta. 18
  - rough meadow, notes on, N. Y. Cornell Sta ... 282
  - rough-stalked meadow, field experiments with, Nebr. Sta ... 254
  - seed, germination tests of, N. C. Sta .. 286
    - impurities of, Del. Sta ... 23
    - vitality of, Del. Sta ... 25
  - tall oat, adaptability to Alabama, Ala. College Sta ... 183
    - field experiments with, Nebr. Sta ... 121
    - notes on, Tex. Sta ... 320
  - Tennessee or mountain oat, notes on, Tenn. Sta ... 317
  - Texas, blue, notes on, Fla. Sta ... 197
    - La. State Sta .. 69
  - timothy, effect of ripeness on crop, Ill. Sta ... 34
    - notes on, Tenn. Sta ... 317
  - water, notes on, N. Y. Cornell Sta ... 282
  - wild wheat, field experiments with, Nebr. Sta ... 121, 254
  - wire, notes on, N. Y. Cornell Sta ... 282
  - wood meadow, notes on, N. Y. Cornell Sta ... 282
  - yard, adaptability to Alabama, Ala. College Sta ... 183
- Grasses and clovers, varieties, Ill. Sta ... 34
  - composition of, Ill. Sta ... 34
    - N. Y. State Sta ... 267
  - digestibility of, Ill. Sta ... 35
  - directions for collecting and preserving, Ala. College Sta ... 183
  - effect of ripeness on crop, Ill. Sta .. 34
  - field experiments with—
    - Mass. State Sta ... 80
    - Nebr. Sta ... 121, 254
    - North La. Sta ... 71
  - for pasture and meadow, Nebr. Sta. 254
    - sandy soil, Mich. Sta ... 228
  - formulas for mixtures, Ala. College Sta ... 183
  - in feeding experiments for beef, N. Y. State Sta ... 270
  - Indiana, description of, Ind. Sta ... 209
  - loss of water in curing, Ill. Sta ... 34
  - meadow, notes on, N. Y. Cornell Sta. 282
  - mountain, notes on, Tenn. Sta ... 316
  - Muehlenbergs, field experiments with, Nebr. Sta ... 121, 254
  - notes on, Tex. Sta ... 320
  - of Alabama and their cultivation .. 183
  - prairie notes on, U. S. D. A ... 168
  - varieties of La. State Sta ... 69
- Green striped worm, notes on, Nebr. Sta ... 120
- Greenhouse walls, construction of—
  - Mass. Hatch Sta ... 83
  - Minn. Sta ... 98

Page.

- Greenhouses, remedy for mildews and insects in, Mass. Hatch Sta ... 83
  - steam *vs.* hot water in heating, Mass. Hatch Sta ... 82, 225
- Guano, analyses of, La. State Sta ... 221
  - bat, analyses of, Fla. Sta ... 198
  - fish, analyses of, N. J. Sta ... 260
  - Mona Island, analyses, Mass. State Sta ... 80
- Guernsey cows, in test of dairy breeds—
  - N. J. Sta ... 258
  - N. Y. State Sta ... 270
- Gypsum, analyses of, Fla. Sta ... 198
  - for cucumber beetles, Ohio Sta ... 291
- Hackberry butterfly, notes on, Colo. Sta ... 10
- *Hæmatobia serrata*, notes on, N. J. Sta ... 260
- *Hæmatopinus suis*, treatment of, Iowa Sta .. 213
- *Haltica striolata*, notes on, Colo. Sta ... 13
- Harlequin cabbage-bug, notes on, Ga. Sta .. 27
- *Harpalus herbivagus*, as locust parasite, Minn. Sta ... 232
- Hatch (Mass.) Experiment Station ... 82, 224
  - Station bulletins ... 82, 224
- Hawk fly as a locust parasite, Minn. Sta ... 231
- Hay, analyses of, Conn. State Sta ... 15
  - Ga. Sta ... 198
  - Mich. Sta ... 90
  - Miss. Sta ... 233
  - N. H. Sta ... 255
  - Vt. Sta ... 157
  - digestibility of, Ill. Sta ... 35
  - effect of ripeness on crop, Ill. Sta ... 34
  - English, in feeding experiments with milch cows, Mass. State Sta ... 223
  - loss of water in curing, Ill. Sta ... 34
  - meadow, in feeding, experiments, Mass. State Sta ... 77
  - methods of making and feeding, Ala. College Sta ... 183
  - presses, competitive trials, Miss. Sta . 101
  - salt, analyses, Mass. State Sta ... 80
  - timothy, in feeding experiments, Iowa Sta ... 210
- Heifers, feeding experiments with, Ark. Sta. 9
- *Helenium autumnale*, poisonous effects of, Miss. Sta ... 233
- *Heliothis armigera*, description and remedies, Oregon Sta ... 295
  - notes on, Colo. Sta ... 13
    - Del. Sta ... 22
- Hemlock trees, notes on, S. Dak. Sta ... 20
- Hemp culture in Europe, U. S. D. A ... 299
  - United States ... 57, 299
  - experiments, Ky. Sta ... 62
- Hereford steers, feeding experiments with, Mich. Sta ... 84
- *Heterodera*, distribution of the genus, Ala. College Sta ... 186
  - *radicicola*, Ala. College Sta ... 185, 186
  - *schachtii*, Ala. College Sta ... 186
- Hickory, black, analysis of, Ga. Sta ... 26
  - trees, notes on, S. Dak. Sta ... 20
- *Hippodamia 13-punctata*, notes on, Ohio Sta. 292
- Hog cholera, bacteriological investigations of, U. S. D. A ... 105

Page.
Hog cholera, causation or etiology, U. S. D. A. 103
  description and treatment of, N. C. Sta 312
  diagnosis by means of inoculation, U. S. D. A 104
  effects of disinfectants on virus of, U. S. D. A 105
  history, nature, and treatment of, U. S. D. A 103
  how swine become infected, U. S. D. A 105
  introduction and spread in the United States, U. S. D. A 103
  outbreak near city of Washington in 1887, U. S. D. A 103
  prevention of, U. S. D. A 106
  relation to public health, U. S. D. A 105
  symptoms and post-mortem appearance, U. S. D. A 103
  treatment, U. S. D. A 106
  louse, remedy for, Iowa Sta 213
Holderness, American, cattle, in test of breeds, N. Y. State Sta 270
Holstein-Friesian cattle, in test of breeds, N. Y. State Sta 270
  cows, test of, N. J. Sta 258
Hominy chops, analyses of, Conn. State Sta. 15
Hopper, green apple-leaf, notes on, Ohio Sta. 291
  rose-leaf, notes on, Ohio Sta 291
Horn fly, notes on, N. J. Sta 260, 264
Horses, treatise on colic of, Ohio Sta 139
Horticulture at Ala. Canebrake Sta 188
  Ala. College Sta 3, 184
  Ark. Sta 188
  Colo. Sta 13
  Ind. Sta 35
  Md. Sta 75
  Mass. Hatch Sta 82, 225
  Mich. Sta 69, 228
  Minn. Sta 94
  Nebr. Sta 122, 254
  N. J. Sta 261
  N. Y. Cornell Sta 276, 283
  North La. Sta 71
  Ohio Sta 287, 293
  Ontario Experimental Farm 246
  Oreg. Sta 142
  Pa. Sta 295
  R. I. Sta 297
  Tenn. Sta 317
  Tex. Sta 319
  Va. Sta 321
  coöperative work of stations in 58
Hydrophobia in cattle, Nebr. Sta 125
Hyphantria cunea, account of, Minn. Sta 232
Hypoxylon, synopsis of American species, U. S. D. A 169
Icerya purchasi, natural enemies in Australia and California, U. S. D. A 301
Illinois, Agricultural Experiment Station of University of 28, 199
  Station bulletins 28, 199
  University of 28, 199

Page
Imported cabbage butterfly—
  notes on, Ga. Sta 26
  S. Dak. Sta 21
Imported currant borer, remedies for, Ohio Sta 138
Indiana Agricultural Experiment Station 35, 204
  Station bulletins 35, 204
Inoculation for prevention of hog cholera, U. S. D. A 107
  in diagnosis of hog cholera, U. S. D. A 104
Insecticides. (See also Arsenites, London Purple, and Paris Green.)
  combination of, with fungicides, Ohio Sta 294
  experiments with, Oreg. Sta. 294
  for cabbage worms, Colo. Sta. 12
  codling moth, Colo. Sta 11
  Iowa Sta 213
  cucumber beetle, Ohio Sta. 291
  eight-spotted forester, Colo. Sta 11
  false chinch bug, Colo. Sta. 12
  garden web-worm, Colo. Sta. 12
  plant louse, Iowa Sta 45
  plum curculio, Mich. Sta. 227
  Ohio Sta 290
  potato beetle, Ohio Sta 292
  kerosene emulsion, Ark. Sta. 9
  Colo. Sta. 11
  Oreg. Sta. 294
  notes on, Colo. Sta 10
  N. C. Sta 138
  Oreg. Sta 142, 295
  S. Dak. Sta 21
  potato-water, Iowa Sta 45
Insects affecting clover, partial bibliography of, Ohio Sta 292
  poplars and willows, Minn. Sta 232
  collecting of, Ala. College Sta 184
  Del. Sta 21
  Ohio Sta 138
  cranberry, investigation of, N. J. Sta. 134
  injurious, identification and extermination of, Del. Sta 22
  of 1888, notes on, Nebr. Sta. 120
  parasitic, for fluted scale, U. S. D. A. 301
Irrigation, notes on waters for, Colo. Sta 191
  subterranean, experiment in, Nebr. Sta 121
Iowa Agricultural Experiment Station 42, 209
  State College of Agriculture and Mechanic Arts 42, 209
  Station bulletins 42, 209
Japan, Imperial College of Agriculture and Dendrology 247
Japanese vegetables, varieties, Ind. Sta 36
Jersey cattle—
  dairy test of, N. J. Sta 258
  Vt. Sta 321
  feeding test of, Mich. Sta 84
  N. Y. State Sta 270
Johnson grass, field tests of, Nebr. Sta 121, 254
Journal of Mycology, Vol. V, U. S. D. A 169

Page.

Juglans nigra, notes on, Ala. College Sta ... 4
Jute culture in the United States ... 57, 299
Kaffir corn, field experiments with, Nebr. Sta ... 122, 254
  test of, Mich Sta ... 89
Kainit, as fertilizer for cotton, N. C. Sta ... 285
  oats, Ark. Sta ... 189
  potatoes, Ala. Canebrake Sta ... 188
  wheat, Va. Sta ... 158
  field experiments with, Ala. College Sta ... 3
  Ga. Sta ... 26
  N. J. Sta ... 132
  S. C. Sta ... 147
  manurial value as compared with phosphates, Ga. Sta ... 26
Kale, variety tests, Mich. Sta ... 89
Kansas Experiment Station ... 46, 214
  State Agricultural College ... 46, 214
  Station bulletins ... 46, 214
Kentucky Agricultural and Mechanical College ... 61, 218
  blue-grass, effects of ripeness on crop, Ill. Sta ... 34
  Experiment Station ... 61, 218
  Station bulletins ... 61, 218
Kerosene as an insecticide, Ark. Sta ... 9
  emulsion as insecticide, Colo. Sta. 11
  for cabbage worms, Colo. Sta ... 12
  false chinch bug, Colo. Sta ... 12
  woolly aphis, Oregon Sta ... 294
Koeleria cristata, notes on, U. S. D. A ... 168
Koji, composition and properties of ... 247
Lady-bird, aquatic, notes on, Ohio Sta ... 292
  beetle, notes on, Mich Sta ... 226
  20-spotted, notes on, Ohio Sta ... 292
Lambs, feeding experiments with, N. Y. Cornell Sta ... 273
Languria mozardi as a gall-maker, Ind. Sta. 41
Lappa officinalis, Wisconsin law concerning, Wis. Sta ... 323
Larch, European, notes on, S. Dak. Sta ... 315
  trees, notes on, S. Dak. Sta ... 20
Larder or bacon beetle, notes on, Mass. Hatch. Sta ... 224
Leaf-roller of grapes, injuries by, Tex. Sta. 319
Leaf-rolling caterpillar, notes on, Colo. Sta. 12
Leaf spot of grapes, notes on, Tex. Sta ... 319
Lean meat in mature animals, experiment in production of, N. Y. Cornell Sta ... 134
Legumes—
  acquisition of nitrogen by, Conn. Storrs Sta ... 194
  field experiments with, Mass. State Sta. 80
  Nebr. Sta ... 122
Lema trilineata, notes on, Colo. Sta ... 13
Leptocoris trivittatus, notes on, Nebr. Sta ... 120
Lespedeza striata, adaptability to Alabama, Ala. College Sta ... 183
Lettuce, growing under glass, Mass. Hatch Sta ... 83

Page.

Lettuce mildew, remedy for, Mass. Hatch Sta. 83
Leucania unipuncta, notes on, Nebr. Sta ... 120
Leucanthemum vulgare, Wisconsin law concerning, Wis. Sta ... 323
Lime, chloride of, for cotton-root rot, Tex. Sta ... 319
  field experiments with, Ala. College Sta ... 3, 6
  gas, field experiments with, Ind. Sta. 39
Limestone, analyses of, La. State Sta ... 221
Lina lapponica, account of, Minn. Sta ... 232
  scripta, account of, Minn. Sta ... 232
  tremulæ, account of, Minn. Sta ... 232
Linaria vulgaris, Wisconsin law concerning, Wis. Sta ... 323
Linseed meal, analyses of, Conn. State Sta.. 15
  Mass. State Sta.. 80
  in feeding experiments, N. Y. State Sta ... 270
  refuse, analysis of, Mass. State Sta ... 80
Listing wheat, experiments in, Kan. Sta ... 215
Listronotus latiusculus, notes on, Ohio Sta.. 292
Live stock. (See also Cattle, Cows, etc.)
  at Alabama College Station ... 7
  Nebraska Station ... 221
  feeding of, in North Carolina, N. C. Sta ... 285
Lixus concavus, notes on, Ohio Sta ... 291
Locust, Rocky Mountain—
  in Otter Tail County, Minn. Sta ... 230
  methods for killing, Minn. Sta ... 231
Locust trees, notes on, S. Dak. Sta ... 20
London purple, effects on foliage, Mich. Sta. 227
  for codling moth, Colo. Sta.. 11
  Ky. Sta ... 63
  Oregon Sta 294
  plum curculio, Ohio Sta. 290
Long-leaved pine, analysis of, Ga. Sta ... 27
Louisiana Experiment Stations ... 63, 220
  State Station, Report for 1888 ... 69
  Station bulletins ... 63, 220
  University and Agricultural and Mechanical College ... 63, 220
Lucern. (See Alfalfa.)
Lupine, acquisition of nitrogen by, Conn. Storrs Sta ... 194
  field experiment with, Nebr. Sta.. 122
  yellow, trial of, Mich. Sta ... 89
Lygus pratensis, account of, Ark. Sta ... 9
Lysimeter at Nebraska Station ... 121
Lytta cinerea, notes on, Colo. Sta ... 13
Magnolia grandiflora, analysis of, Ga. Sta ... 27
Macrodactylus subspinosus, notes on, Del. Sta. 22
Maine State College Experiment Station ... 73
  of Agriculture and Mechanic Arts ... 73
  Station bulletins ... 73
Maize. (See Corn.)
  yellow millo, field experiments with, Nebr. Sta ... 254
Malt sprouts, analyses of, Conn. State Sta.. 15
  N. Y. Cornell Sta. 282
Mammals, description of new North American, U. S. D. A ... 109

Page.
Mangel-wurzels, effects of fertilizers on, Mich. Sta 87
germination tests of, Pa. Sta 295
varieties, Mich. Sta 87
Manitoba, experimental farm of 215
Manure, farm—
ammonia lost in drying, N. C. Sta 138
analyses of, Tenn. Sta 149
field experiments with, Ill. Sta 33
Ind. Sta 39
from feeding cotton-seed hulls and meal, Tenn. Sta 315
loss by leaching and fermentation, N. Y. Cornell Sta 279
methods of application, N. H. Sta 127
sources of, Minn. Sta 229
value from different feeding stuffs, Mass. State Sta 222
vs. commercial fertilizers—
Ind. Sta 39
Ky. Sta 62
N. H. Sta 128
Maple, red, analysis of, Ga. Sta 26
trees, notes on, S. Dak. Sta 20
Marl, analyses, Ala. College Sta 181
Fla. Sta 25
La. State Sta 221
Tenn. Sta 149
Marsh hay, analysis of, Mich. Sta 90
Maryland Agricultural College 74, 222
Experiment Station 74, 222
Station bulletins 74, 222
Massachusetts Agricultural College 82, 224
Hatch Experiment Station. 82, 224
Station bulletins 82, 224
State Experiment Station 77, 222
Station bulletins 77, 222
Meadow fescue, effect of ripeness on crop, Ill. Sta 34
foxtail, field experiments with, Nebr. Sta 121
Meat inspectors, school for, Minn. Sta 229
Melilotus alba, experiments with, Mass. State Sta 89
Melon, orange, notes on, N. Y. Cornell Sta. 283
rust, treatment of, U. S. D. A 168
worm, notes on, Ga. Sta 27
Meteorology, Ala. College Sta 4, 7
Ga. Sta 27
Ind. Sta 207
La. State Sta 69
Md. Sta 75
Mass. Hatch Sta 225
Mass. State Sta 77, 80, 222
Mich. Sta 84
Mo. Sta 102
Nebr. Sta 121, 123
Nev. Sta 127, 255
R. I. Sta 298
S. C. Sta 312
Va. Sta 322
Mice, North American pocket, revision of, U. S. D. A 109
Michigan Agricultural College 84, 226

Page.
Michigan Experiment Station 84, 226
Station bulletins 84, 226
Middlings, analysis of, N. H. Sta 255
in feeding experiments for milk, N. H. Sta 255
rye, in feeding experiments for milk, Mass. State Sta 223
wheat, in feeding experiments for beef, N. Y. State Sta 270
Mildew, apple powdery, treatment of, U. S. D. A 170
downy, of grapes—
notes on, Tex. Sta 319
treatment of, U. S. D. A. 170
in greenhouses, remedy for, Mass. Hatch Sta 83
powdery, of grapes—
notes on, Tex. Sta 319
U. S. D. A 170
Milk, analyses of, Mass. State Sta 77
N. J. Sta 258, 260
N. Y. Cornell Sta 281
and its products, bacteria in, Conn. Storrs Sta 192
bacteria in, Wis. Sta 164
basis of price at Vermont creameries, Vt. Sta 321
chemical composition of, Wis. Sta 161
composition of first half and last half of milkings, Ind. Sta 40
economy in production, Mass. State Sta 223
effect of climate, N. Y. Cornell Sta 281
heating, N. Y. Cornell Sta 135
temperature—
Conn. Storrs Sta 192
Wis. Sta 163
warm water for cows—
Ind. Sta 40
Wis. Sta 324
feeding experiments for—
Mass. State Sta 77
N. H. Sta 255
N. Y. State Sta 269
Ohio Sta 141
ferments in, Wis. Sta 164
fibrin of, Wis. Sta 162
from cows of different breeds—
N. J. Sta 258, 260
N. Y. State Sta 268
Vt. Sta 321
loss of butter in churning, W. Va. Sta 323
microscopical examination of, Ind. Sta 40
mirror of cows, W. Va. Sta 161
production, experiments in, Ind. Sta. 40
required per space of cream, Mass. State Sta 81
secretion, studies in, Ind. Sta 41
setting and churning, methods of, Ala. College Sta 184
methods of, N. H. Sta 130
vs. creaming with the De Laval separator, Ala. College Sta 184

Page.
Milk tests at creameries, Vt. Sta 320
Milkings, fat globules of first half and last half, Ind. Sta 40
Millet, field experiments with, Nebr. Sta .122, 254
Texas, adaptability to Alabama, Ala. College Sta 183
varieties, Iowa Sta 212
Millo maize, field experiments with, Nebr. Sta 122
Minnesota Experiment Station 91, 229
Station bulletins 91, 229
University of 91, 229
Miso, manufacture and composition of..... 247
Mississippi Experiment Station 101, 233
State Agricultural College 101, 233
Station bulletins 101, 233
Missouri Agricultural College...........101, 249
Experiment Station 101, 249
Station bulletins...........101, 249
Mite, red, as a locust parasite, Minn. Sta .. 231
Moisture, relation to cotton plant, S. C. Sta. 313
Moth, clothes, notes on, Mass. Hatch Sta .. 224
Mountain meadows, grasses of, Tenn. Sta .. 316
Muck, analysis of, Fla. Sta 25, 198
general characteristics of, Fla. Sta .. 198
Mucor, relation to root rot of cotton, Tex. Sta 319
Mucronoporus, notes on, U. S. D. A 169
Mud crab, analyses of, Mass. State Sta 80
Muehlenberg grasses, field experiments with, Nebr. Sta 121
Mulberries, varieties, Mich. Sta 229
Mules, diseases of, Miss. Sta 101
food for, Miss. Sta 233
Musk-melons, varieties, Nebr. Sta 254
Mustard, white, tests of, Pa. Sta 143
Mycoderma vini in silage, Ill. Sta 201
Mycology, department of, Conn. State Sta. 15
Journal of, Vol. V, U. S. D. A ... 169
Nebraska Experiment Station 120, 252
Industrial College of the University of 120, 252
Station bulletins...........120, 252
Nematode, as cause of a potato disease, Tenn. Sta 150
root-gall, life history and metamorphoses of, Ala. College Sta. 185
Nematus ventralis, notes on, Minn. Sta 232
ventricosus, notes on, Del. Sta 22
Ohio Sta 291
Nevada Agricultural Experiment Station .127, 255
State University 127, 255
Station bulletins...........127, 255
New Hampshire College of Agriculture and the Mechanic Arts 127, 255
Experiment Station 127, 255
Station bulletins 127, 255
New Jersey State and College Agricultural Experiment Stations 130, 256
Station bulletins...........130, 256
New Mexico Agricultural College........... 248
Experiment Station 248
New York Cornell Experiment Station ...134, 271
Station bulletins 134, 271
University...........134, 271
New York State Experiment Station....... 265
Station bulletins 265
Night-soil, as a manure in Japan........... 247
Nitrate of soda—
analyses of, Conn. State Sta. 15
as fertilizer for corn, Ill. Sta 33
Vt. Sta 156
oats, Ark. Sta 189
potatoes, Ky. Sta 219
wheat, Va. Sta 158
cost of nitrogen from, Conn. State Sta . 16
field experiments with, N. J. Sta....... 132
S. C. Sta....... 147
Nitrogen as fertilizer for wheat, Ohio Sta .. 289
atmospheric, as plant food, Conn. Storrs Sta 194
determination of, N. Y. Cornell Sta. 136
free extract in corn fodder, Ill. Sta 29
hay products, Ill. Sta 34
in feeding stuffs, Conn. State Sta. 14
Mass. State Sta. 77
fertilizers—
cost of, Conn. State Sta 16
N. J. Sta 258
for cotton, Ala. College Sta. 5, 6
sugar-cane, La. Sugar Sta 67
valuation of, N. J. Sta 131
field experiments with fertilizers, S. C. Sta 147
hay products, Ill. Sta 34
relation of amounts in fertilizers and in crop, Ky. Sta 62
Noctuidæ spp., account of, Iowa Sta 45
North American Fauna, Nos. 1 and 2, U. S. D. A 109
North Carolina Agricultural Experiment Station 136, 283
Station bulletins.........136, 283
North Dakota Agricultural College 248
Experiment Station 248
North Louisiana Station, Annual Report of, 70
bulletin 70
Notonecta undulata, notes on, Ohio Sta 292
Nova Scotia, experimental farm of 245
Nummularia, synopsis of American species of, U. S. D. A 169
Nutritive ratio, explanation of, Ill. Sta 34
value of feeding stuffs, Mass. State Sta 223
Nysius angustatus, notes on, Colo. Sta 10
Oak leaves, analyses, Mass. State Sta 80
post, analysis of, Ga. Sta 26
red, analysis of, Ga. Sta 26
trees, notes on, S. Dak. Sta 20
white, analysis of, Ga. Sta 26
notes on, S. Dak. Sta 315
Oat bran, analysis of, Conn. State Sta 15
grass, tall, field experiments with, Nebr. Sta 121
tall meadow, notes on, Tex. Sta .. 320
middlings, analysis of, Conn. State Sta. 15
Oats, analyses of, Conn. State Sta 15

Page.

Oats, field experiments with, Ala. Canebrake Sta 187
  Conn. Storrs Sta. 191
  Ill. Sta 202
  Md. Sta 75
  Mass. State Sta. 80
  S. C. Sta 146
  S. Dak. Sta 19
 germination of frosted, S. Dak. Sta 19
  tests of, Pa. Sta 295
 in feeding experiments, Mass State Sta 77
 salt as fertilizer for, Kan. Sta 215
 smut of, Ind. Sta 207
  Kan. Sta 216
  Nebr. Sta 252
 varieties, Ark. Sta 189
  Ill. Sta 203
  Iowa Sta 210
  La. State Sta 69
  Md. Sta 75
  Mich. Sta 87
  Nebr. sta 122, 123, 254
  Pa. Sta 142, 143
  S. C. Sta 148
Ocneria dispar, description and remedies, Mass. Hatch Sta 225
Office of Experiment Stations, publications of 2
Ohio Agricultural Experiment Station 138, 287
 Station bulletins 138, 287
 Station, eighth annual report of 294
Oil-cake, value for feeding and manure, Minn. Sta 230
Okra, varieties, Nebr. Sta 251
Ongarth's liquid tree protector, Colo. Sta ... 11, 12
Onions, mold of, notes on, N. Y. Cornell Sta. 283
 varieties, Ind. Sta 35
  Md. Sta 76
  Nebr. sta 123, 254
Onobrychis sativa, experiments with, Mass. State Sta 80
Ontario, Agricultural College and Experimental Farm of 245
Orange, gum disease of, U. S. D. A 168
Orchard and garden, La. State Sta 69
 apple, effect of spraying, Ky. Sta .. 63
 fruits, varieties, Md. Sta 76
 grass, effect of ripeness, Ill. Sta 34
  for pastures, Ill. Sta 35
  vs. timothy, Ill. Sta 3
 of Maryland Station 74
  North Louisiana Station 71
  Oregon Station 142
  Virginia Station 321
Oregon Experiment Station 142, 294
 State Agricultural College 142, 294
 Station bulletins 142, 294
Ornithology and mammalogy, division of, U. S. D. A 60
Orthoptera of Nebraska, notes on, Nebr. Sta. 120
Oyster interests of New Jersey, N. J. Sta ... 134
Ozonium auricomum, notes on, Tex. Sta 319
Panicum barbinode, experiments with, La. State Sta 69

Page.

Panicum genus, in the United States, revision of, U. S. D. A 168
 proliferum, adaptability to Alabama, Ala. College Sta 183
 texanum, adaptability to Alabama, Ala. College Sta 183
 virgatum, notes on, U. S. D. A 168
Paper bags as a protection for grapes, Ala. College Sta 4
Pará grass, experiments with, La. State Sta 69
Parasites of fluted scale in Australia, U. S. D. A 301
Paris green, effects upon foliage, Mich. Sta. 227
  for codling moth, Colo. Sta 11
  eight-spotted forester, Colo. Sta 11
  garden web-worm, Colo. Sta 12
  plum curculio, Mich Sta ... 227
Parsley, varieties, Nebr. Sta 123
Parsnip butterfly, notes on, Colo. Sta 11
Parsnips, varieties, Nebr. Sta 254
Paspalum dilatatum, notes on, Tex. Sta 320
 platycaule, notes on, Tex. Sta 320
 pubiflorum, notes on, Tex. Sta ... 320
Peach rot and blight, notes on, U. S. D. A .. 169
 remedy for, U. S. D. A 169
 yellows, history and characteristics of, U. S. D. A 169
Peaches, spotting of, Ind. Sta 36
  U. S. D. A 169
 varieties, Mich. Sta 229
Pea-nuts, field experiments with—
 Ala. College Sta 3
 N. C. Sta 284
Pear blight, treatment of, U. S. D. A 168
 leaf blight, notes on, N. Y. Cornell Sta. 283
  treatment of, U. S. D. A ... 170
Pears, varieties, Mich. Sta 229
Pear-tree slug, notes on, Colo. Sta 12
Peas, acquisition of nitrogen from air by, Conn. Storrs Sta 191
 deep *vs.* shallow planting of, Ind. Sta. 36
 field experiments with, Nebr. Sta 122
 in feeding experiments for beef, N. Y. State Sta 270
 influence of soil upon, N. Y. Cornell Sta 283
 varieties, Ala. College Sta 184
  Ind. Sta 35
  Nebr. Sta 122, 254
Peat, analyses, Mass. State Sta 80
Pea-vine silage, analyses of, Miss. Sta 233
Pea-vines, test of value for cane land, La. Sugar Sta 67
Pea-weevil, method of destroying, Mo. Sta. 102
 notes on, Colo. Sta 12
Pecans, test of, Mich. Sta 229
Peine-Thomas scoria. (See Thomas slag.)
Penicillium in cotton-root rot, Tex. Sta 319
Pennisetum spicatum, field experiments with, Nebr. Sta 122
Pennsylvania Experiment Station 142, 295
 State College 142, 295
 Station bulletins 142, 295

Page.

- Peppers, varieties, Nebr. Sta 123
- *Peronospora gangliformis*, remedy for, Mass. Hatch Sta 83
  - *schleideniana*, notes on, N. Y. Cornell Sta 283
  - *viticola*, notes on, Tex. Sta 319
- *Peronosporeæ* and rain-fall in Iowa, U. S. D. A 169
- Peroxide of silicates for cucumber beetles, Ohio Sta 291
- *Phalacrus* (sp.?), enemy of smut in oats, Kan. Sta 216
- *Phleum pratense*, notes on, Tenn. Sta 317
- Phosphates—
  - analyses, Ala. College Sta 184
  - as fertilizer for cotton, N. C. Sta 285
    - oats, Ark. Sta 189
    - potatoes, Ky. Sta 219
    - wheat, Va. Sta 158
  - field experiments with, Ala. College Sta 3, 6
    - Ga. Sta 26
  - manurial value of, compared with kainit, Ga. Sta 26
  - Pamunkey marl, analysis, N. C. Sta 138
  - raw, as fertilizer for oats, Ala. Canebrake Sta 187
    - potatoes, Ala. Canebrake Sta 188
  - slag, field experiments with, Ga. Sta 26
  - South Carolina, as fertilizer for corn, Vt. Sta 156
  - Star Bone, field experiments with, N. Y. Cornell Sta 283
- Phosphoric acid—
  - as fertilizer for wheat, Ohio Sta 289
  - in feeding stuffs, Conn. State Sta 14
    - fertilizers, cost of, Conn. State Sta 16
      - N. J. Sta 258
    - field experiments, S. C. Sta 147
  - on cotton, Ala. College Sta 5
    - sugar cane, La. Sugar Sta 66
  - relation of amounts in fertilizers and in crop, Ky. Sta 62
  - valuation of, N. J. Sta 131
  - value of, in feeding stuffs, Mass. State Sta 77
- *Phyllosticta labruscæ* of grapes, notes on, Tex. Sta 319
- Physics of soil, notes on, S. C. Sta 312
- Physiology, vegetable, department of, at Mass. State Sta 81
- *Phytophthora infestans*—
  - description and treatment, Tenn. Sta 150
  - experiment in treating, Ohio Sta 291
  - notes on, Me. Sta 74
    - Mass. Hatch Sta 225
    - N. J. Sta 264
- *Picea alba*, notes on, S. Dak. Sta 20
- Pickle-worm, notes on, Ga. Sta 27
- *Pieris oleracea*, notes on, Colo. Sta 12
  - *protodice*, notes on, Colo. Sta 10, 12
  - *rapæ*, account of, Ga. Sta 26
    - notes on, Colo. Sta 10, 11
      - Del. Sta 22

Page.

- Pig-feeding experiments, Ala. College Sta 7
  - Kan. Sta 216
  - Ky. Sta 63
  - for lean meat, N. Y. Cornell Sta 134
- Pigs, effect of various foods upon vital parts and bones, Kan. Sta 217
  - influence of modern feeding upon skull and dentition, Minn. Sta 100
- Pine barrens of Michigan, experiments on, Mich. Sta 228
  - Scotch, notes on, S. Dak. Sta 315
  - trees, analysis of, Ga. Sta 26, 72
    - notes on, S. Dak. Sta 20
  - white, notes on, S. Dak. Sta 315
- *Pinus mitis*, analysis of, Ga. Sta 26
  - *palustris*, analysis of, Ga. Sta 27
  - *ponderosa*, notes on, S. Dak. Sta 20
- Pitchy carpet beetle, notes on, Mass. Hatch Sta 224
- *Plagiodera scripta*, notes on, Colo. Sta 12
- Plant-louse, box-elder, notes on, Nebr. Sta 120
  - grain, account of, Mich. Sta 91
  - insecticide for, Iowa Sta 45
- Plants, collection of, Ala. College Sta 184
  - distribution at California Station, Cal. Sta 190
  - fungus diseases of, Conn. State Sta 15
  - poisonous, experiment in feeding to cattle, Oregon Sta 295
- Plaster, analyses of, Tenn. Sta 149
  - as fertilizer for potatoes, Ky. Sta 219
  - carbolized, for plum curculio, Mich. Sta 227
  - field experiments with, N. J. Sta 132
- *Platanus occidentalis*, analysis of, Ga. Sta 26
- *Platysamia cecropia*, notes on, Minn. Sta 232
  - S. Dak. Sta 21
- Plowing, deep and shallow, for corn, Ind. Sta 38
- *Plowrightia morbosa*, notes on, Mass. Hatch Sta 225
- Plum, black knot of, remedies for, Mass. Hatch Sta 225
  - curculio, account of, Iowa Sta 45
    - experiments in rearing, Ind. Sta 41
    - insecticides for, Mich. Sta 227
    - notes on, Del. Sta 22
    - remedies for, Ohio Sta 290
  - leaf rust, treatment of, U. S. D. A 169
  - wart, remedies for, Mass. Hatch Sta 83
- Plums, native, test of, Minn. Sta 94
  - varieties, Mich. Sta 220
  - wild, account of tests, Iowa Sta 42
    - varieties, Iowa Sta 42
- *Plusia brassicæ*, notes on, Colo. Sta 12
- *Poa aquatica*, notes on, N. Y. Cornell Sta 282
  - *arachnifera*, experiments with, La. State Sta 69
    - notes on, Fla. Sta 197
  - *compressa*, notes on, N. Y. Cornell Sta 282
  - *nemoralis*, notes on, N. Y. Cornell Sta 282
  - *pratensis*, field experiments with, Mass. State Sta 80
    - notes on, N. Y. Cornell Sta 282

Page.

- *Poa serotina*, notes on, N. Y. Cornell Sta 282
  - *trivialis*, notes on, N. Y. Cornell Sta 282
- Pocket mice, North American, revision of; U. S. D. A 109
- Pollen, effects of rain upon, N. J. Sta 131
- Pond life, studies in, Ohio Sta 292
- Poplar borer, notes on, Colo. Sta 12
  - Minn. Sta 232
  - girdler, notes on, Minn. Sta 232
- Poplars, directions for growing cuttings, Minn. Sta 232
  - growth from hard-wood cuttings, Minn. Sta 93
  - insects affecting, Minn. Sta 232
  - Russian, notes on, S. Dak. Sta 315
    - varieties, S. Dak. Sta 315
  - varieties, Minn. Sta 232
- *Populus alba*, growth from hard-wood cuttings, Minn. Sta 93
  - *certinensis*, notes on, S. Dak. Sta 20, 315
  - *monilifera*, notes on, Nebr. Sta 253
  - *nolester*, notes on, S. Dak. Sta 20
  - *pyramidalis*, notes on, S. Dak. Sta 20
- Potash, cost from different sources—
  - Conn. State Sta 16
  - N. J. Sta 258
  - experience of New Jersey farmers with, N. J. Sta 133
  - for corn, N. J. Sta 132
    - sorghum, N. J. Sta 132
    - sugar-cane, La. Sugar Sta 65
    - sweet potatoes, N. J. Sta 132
    - wheat, Ohio Sta 289
  - in feeding stuffs, Conn. State Sta 14
    - Mass. State Sta 77
    - fertilizers, need of in Indiana, Ind. Sta 73
    - field experim'ts, Ala. College Sta 62
      - N. J. Sta 131
      - S. C. Sta 117
  - muriate of—
    - as fertilizer for corn, Ill. Sta 33
      - Vt. Sta 156
    - for home-mixed manures, N. H. Sta 129
    - in field experiments, N. J. Sta 132
      - S. C. Sta 147, 148
  - relation of amounts in fertilizers and in crop, Ky. Sta 62
  - salts, analyses of, Conn. State Sta 15
  - sulphate of, as fertilizer for potatoes, Ky. Sta 219
    - for black-rot of grapes, Del. Sta 196
  - valuation of, N. J. Sta 131
- Potassium sulphide, for gooseberry mildew and apple scab, U. S. D. A 169
- Potato beetle, Colorado, Del. Sta 22
  - Ohio Sta 138
  - S. Dak. Sta 21
  - blight and rot, remedies for, Mass. Hatch Sta 225
  - new disease of, Tenn. Sta 150
  - plant in New York, little-known enemies of, Ind Sta 41

Page.

- Potato rot, description and treatment, Tenn. Sta 150
  - experiment in treating, Ohio Sta 291
  - notes on, Me. Sta 71
    - Mass. Hatch Sta 225
    - N. J. Sta 264
  - scab, discussion of, U. S. D. A 168
    - experiments with, Mass. State Sta 80
  - sweet, rot of, N. J. Sta 265
  - water as an insecticide, Iowa Sta 45
- Potatoes—
  - determination of starch in, Colo. Sta 13
  - field experiments with—
    - Ala. Canebrake Sta 188
    - Ind. Sta 35
    - Ky. Sta 219
    - Mass. State Sta 80
    - Mich. Sta 86
    - N. C. Sta 284
  - in pig-feeding experiment, Kan. Sta 216
  - methods of culture, Minn. Sta 94
    - planting and culture—
      - Ky. Sta 219
      - R. I. Sta 297
  - preparation of seed, Ky. Sta 219
    - Mich. Sta 86
    - R. I. Sta 297
  - Rural trench system of planting, Ind. Sta 35
  - sweet, field experiments with, Ala. College Sta 3
    - preservation of, Ga. Sta 27
    - varieties, Nebr. Sta 254
    - vines, analyses of, Ga. Sta 198
  - varieties, Ala. Canebrake Sta 188
    - Ala. College Sta 184
    - Colo. Sta 13
    - Ind. Sta 35
    - Ky. Sta 219
    - Md. Sta 76
    - Mass. Hatch Sta 84
    - Mich. Sta 86, 89
    - Minn. Sta 99
    - Nebr. Sta 122, 254
    - Pa. Sta 142, 143
    - R. I. Sta 297
- *Psyllobora 20-maculata*, notes on, Ohio Sta 292
- Publications of—
  - Office of Experiment Stations 2
  - stations, editorial notes on 310
    - list of 52, 113, 172, 241, 304
    - number issued during 1889 118
  - U. S. D. A., abstracts of 103, 168, 235, 299
    - list of 50, 111, 171, 240, 303
- *Puccinia graminis*, *P. coronata* and *P. rubigo-vera*, of wheat rust, Ind. Sta 204
- Pumpkins, varieties, Nebr. Sta 254
- Purdue University 35, 204
- *Quercus alba*, *Q. obtusifolia*, and *Q. rubra*, analyses of, Ga. Sta 26
- Quince, leaf-blight of, N. Y. Cornell Sta 283
  - spot of, Ohio Sta 291
- Quinces, varieties, Mich. Sta 229
- Radishes, varieties, Nebr. Sta 254

Page.
Railways, metal track, as a substitute for wooden ties, U. S. D. A. 109
relation to timber resources of United States, U. S. D. A. 110
Rain-fall charts of Michigan, Mich. Sta. 84
Rain-gauges, observations with, Nebr. Sta. 123
Ramie culture in the United States 57, 299
variety tests discussed 57
Raspberries, varieties, Mich. Sta 229
Ohio Sta 287
Tex. Sta 320
Raspberry culture, directions for, Ala. College Sta 5
Red-striped cranberry worm, notes on, N. J. Sta 134
Red top, field experiments with, Nebr. Sta. 121
Reports of stations for 1888, Digest of 1
Rescue grass, field experiments with, Nebr. Sta 121
Rhode Island Experiment Station 145, 296
State Agricultural School 145, 296
Station bulletins 145, 296
farm 146
organization of 145
Rhopobota (Anchylopera) vacciniana, notes on, N. J. Sta 134
Rhynchites bicolor, notes on, Colo. Sta 12
Rice and its by-products, La. State Sta 220
composition of, La. State Sta 221
fertilizer experiments with 247
field experiments with, La. State Sta 220
milling products of, La. State Sta 221
products, analyses of, La. State Sta 221
distribution of nutrients in 247
Root-galls, investigations in nature and causes of, Ala. College Sta 185
Root growth of corn, Ill. Sta 32
Minn. Sta 91
pruning of corn, Ill. Sta 31, 32
Ind. Sta 39
Minn. Sta 92
Root-rot of cotton, description and treatment of, Tex. Sta 318
Roots, cultivation of, N. Y. Cornell Sta 283
in feeding experiments—
Mass. State Sta 77
Va. Sta 321
of plants as manure, Conn. Storrs Sta. 18
Root tubercles, distinguished from root-galls, Ala. College Sta 186
relation to nitrogen supply of plants, Conn. Storrs Sta 194
Rose beetle, notes on, Del. Sta 22
Rose-leaf blight, remedy for, Mass. Hatch Sta 83
spot, remedies for, Mass. Hatch Sta 225
Rose mildew, Mass. Hatch Sta 83
Rot, bitter, of apple, treatment, U. S. D. A. 169
of grapes, U. S. D. A. 170
potato, treatment of, Ohio Sta 291
Tenn. Sta 150
Rotation of crops—
experiments in, La. State Sta 70

Page.
Rotation of crops—
experiments in, Md. Sta 76
vs. continuous grain growing, Ind. Sta. 206
Round-headed borer, notes on, Iowa Sta 45
Rowen, in feeding experiments with milch cows, Mass. State Sta 223
Rumex crispus, Wisconsin law concerning, Wis. Sta 324
Rust of wheat, analyses, Minn. Sta 99, 100
effects on germination, Minn. Sta 94
on wheat and cotton, N. C. Sta 138
Rusts of Nebraska, preliminary enumeration of, Nebr. Sta 253
Ruta-bagas, germination tests of, Pa. Sta 295
varieties, Mich. Sta 87
Rye bran, analyses of, Conn. State Sta 15
feed, analyses of, Conn. State Sta 15
grass, perennial, field experiments with, Nebr. Sta 121
hay in feeding experiments for milk, N. H. Sta 255
in feeding experiments for beef, N. Y. State Sta 270
Saccharomyces mycoderma, in silage, Ill. Sta. 201
Sainfoin, field experiments with—
Mass. State Sta 80
Nebr. Sta 122
Salix fragilis, notes on, S. Dak. Sta 20
laurifolia, notes on, S. Dak. Sta 20
Salsify, varieties, Nebr. Sta 254
Salt as a fertilizer for oats, Kans. Sta 215
San Joaquin Valley lakes, Cal. Sta 10
Saperda calcarata, notes on, Colo. Sta 12
Minn. Sta 232
concolor, notes on, Minn. Sta 232
Saw-fly borer in wheat, notes on, N. Y. Cornell Sta 277
gooseberry, Del. Sta 22
large willow, notes on, Nebr. Sta 120
raspberry, remedies for, Ohio Sta 138
Scelio, new species, as a locust parasite, Minn. Sta 231
Schizoneura lanigera, treatment with kerosene, Oregon Sta 294
Sclerostomum equinum, as cause of colic in horses, Ohio Sta 139
Screenings, chemical composition, Mich. Sta 90
Seeding of wheat, experiments in, Ky. Sta 218
Ohio Sta. 287
Seeds, apparatus used in tests of, N. Y. Cornell Sta 271
conditions of germination, N. Y. Cornell Sta 271
distribution of, Cal. Sta 190
effects of age on germination of—
N. C. Sta 137
Pa. Sta 295
effects of different depths of planting, N. Y. Cornell Sta 283
from Puget Sound, merits of, Ohio Sta 294
garden, impurities in, N. Y. Cornell Sta 272

Page.

- Seeds, germination of frosted, S. Dak. Sta. 19
  - inspection of, Del. Sta 22
    - N. Y. Cornell Sta 271
  - of weeds, vitality of, N. Y. Cornell Sta 282
  - tests of, Del. Sta 23
    - Md. Sta 76
    - Mo. Sta 102
    - N. Y. Cornell Sta 271
    - N. C. Sta 136, 286
    - Oregon Sta 142
    - Pa. Sta 295
- *Selandria cerasi*, notes on, Colo. Sta 12
    - Ohio Sta 291
  - *rubi*, notes on, Colo. Sta 13
- Separator, centrifugal, effects on cream, Wis. Sta 163
    - use in butter making, Tex. Sta 151
  - De Laval, in creaming experiment, Ala. College Sta 184
- Serradella, acquisition of nitrogen from air by, Conn. Storrs Sta 194
  - field experiments with—
    - Mich. Sta 89
    - Nebr. Sta 122
  - in feeding experiments, Mass. State Sta 77
- Sheep, entozoic diseases of, Miss. Sta 233
  - fodder, field experiment with, Mich. Sta 89
- Shorthorn Cows, test of, N. J. Sta 258
- Shorts, analysis of, N. H. Sta 255
  - in feeding experiments for milk, N. H. Sta 255
  - in pig-feeding experiment, Kan. Sta. 216
- Shrubs, propagation from cuttings, Iowa Sta 44
- *Sida spinosa*, root rot of, Texas Sta 319
- Silage, acid in, Ill. Sta 202
  - alcoholic fermentation in, Ill. Sta 201
  - biology of, Ill. Sta 200
  - chemical composition of, Ill. Sta 202
    - Mich. Sta. 90
  - corn, in feeding experiments—
    - Iowa Sta 210
    - Mass. State Sta 77
  - crop, methods of growing and harvesting, Kan. Sta 48
  - experiments with clover, Minn. Sta. 229
  - feeding rations of, Ohio Sta 140
    - Wis. Sta 167
  - fermentation of, Ill. Sta 200
    - Wis. Sta 167
  - in feeding experiments for beef—
    - Iowa Sta 210
    - Tex. Sta 153
    - Va. Sta 321
  - in feeding experiments for milk—
    - Minn. Sta 96
    - N. H. Sta 255
    - Ohio Sta 140
  - methods of feeding, Mich. Sta 87
  - notes on, Wis. Sta 164
  - sweet, Ill. Sta 202

Page.

- Silage, time to cut corn for, Minn. Sta 97
  - varieties of corn for, Ind. Sta 39
    - Ohio Sta 140
    - Wis. Sta 165
  - *vs.* dry fodder—
    - cost of storing, Mo. Sta 249
    - digestion experiment, Pa. Sta 296
    - feeding experiments, Mich. Sta. 88
      - Mo. Sta 250
    - field beets, for production of milk, Ohio Sta 141
    - nutritive value of, Mo. Sta 249
  - views of Michigan farmers on, Mich. Sta 88
- Silk section of U. S. Department of Agriculture 301
- Silk-worms, directions for raising 301
  - notes on, Minn. Sta 232
    - S. Dak. Sta 21
- Silos and barns, relative cost of, Mo. Sta 249
  - construction of, Kan. Sta 47
    - Mich. Sta 87
    - Miss. Sta 233
    - Mo. Sta 249
    - N. C. Sta 286
    - Ohio Sta 139
    - Wis. Sta 165
  - filling of, Kan. Sta 48
    - Mich. Sta 87
    - Wis. Sta 165
  - location of, Kan. Sta 47
    - Mich. Sta 87
    - Ohio Sta 139
  - notes on, Kan. Sta 46
    - Mich. Sta 87
    - Miss. Sta 233
    - Mo. Sta 249
    - N. C. Sta 286
    - Ohio Sta 139
    - Wis. Sta 165
  - special value to Kansas, Kan. Sta 47
  - stone, unsuccessful experiments with, Kan. Sta 47
- *Siphonophora avenæ*, notes on, Ind. Sta 41
    - Ky. Sta 219
    - Mich. Sta 91
    - Ohio Sta 291
- Sirups from sorghum, Iowa Sta 44
- Slug shot for cucumber beetles, Ohio Sta 291
- Smut of oats, natural enemies of, Kan. Sta. 216
  - preliminary report on, Kan. Sta 216
  - wheat and oats, Ind. Sta 207
  - stinking, account of, Ind. Sta 208
- Smuts of Nebraska, preliminary enumeration of, Nebr. Sta 253
- Snapdragon, Wisconsin law concerning, Wis. Sta 323
- Snout beetle, notes on, Ohio Sta 291
- Soil temperature, Ala. Canebrake Sta 8
    - Ala. College Sta 4, 5, 184
    - Minn. Sta 95
    - Nebr. Sta 121, 123
  - tests with fertilizers, N. H. Sta 128
    - proposed, Md. Sta 76

Page.

- Soil thermometer, new form of, S. C. Sta ... 312
- Soils, alkaline, Cal. Sta ... 10
  - analysis of, Ala. College Sta ... 3, 7
    - Fla. Sta ... 25, 198
    - Mass. State Sta ... 80
    - Mo. Sta ... 101
  - and alkali, discussion of, Colo. Sta ... 191
  - geology of, Ga. Sta ... 26
  - physics of, S. C. Sta ... 312
  - reduction in fertility, Ind. Sta ... 37
  - restoration of fertility, Conn. Storrs Sta ... 195
  - sandy, experiments in management of, Mich. Sta ... 228
- *Sonchus arvensis*, Wisconsin law concerning, Wis. Sta ... 324
- Soot, analyses of, N. Y. Cornell Sta ... 282
- Sorghum, analyses of, Iowa Sta ... 44
  - experiments in sugar making—
    - Iowa Sta ... 44, 212
    - U. S. D. A ... 300
  - field experiments with—
    - Mass. State Sta ... 80
    - Md. Sta ... 75
    - N. J. Sta ... 132
    - U. S. D. A ... 300
  - silage, analysis of, Miss. Sta ... 233
  - varieties, Md. Sta ... 75
- South Carolina Experiment Station ... 146, 312
  - Station bulletins ... 146, 312
  - University of ... 146, 312
- South Dakota Agricultural College ... 18, 315
  - Experiment Station ... 18, 315
  - Station bulletins ... 18, 315
- South Haven substation, fruit testing at, Mich. Sta ... 228
- Spaying of cows, Ark. Sta ... 8
- Sparrow, English, in North America, U. S. D. A ... 108
- *Spergula maxima*, trial of, Mich. Sta ... 89
- *Spermophilus 13-lineatus*, food habits of, Iowa Sta ... 211
- *Sphaceloma ampelinum*, notes on, Tex. Sta ... 319
- *Sphærella fragariæ*, notes on, N. Y. Cornell Sta ... 281
- *Sphærotheca phytoptophila*, U. S. D. A ... 169
- Sphinx moths, notes on, S. Dak. Sta ... 21
- *Sphæria morbosa*, remedies for, Mass. Hatch Sta ... 83
- Spider, red, account of, Iowa Sta ... 45
  - remedy for, Mass. Hatch Sta ... 83
- Spotting of peaches and cucumbers, Ind. Sta ... 36
- Spraying apparatus, descriptions of, Oregon Sta ... 295
- Spruce trees, notes on, S. Dak. Sta ... 20
- Spurrey, field experiments with, Nebr. Sta ... 122
- Squash bug, notes on, Colo. Sta ... 10, 11
- Squashes, cross-fertilization of, Mich. Sta ... 89
- Squirrel, striped prairie, food habits of, Iowa Sta ... 211
- Star Bone phosphate, field experiments with, N. Y. Cornell Sta ... 283
- Starch feed, analyses of, Conn. State Sta ... 15
- Starch in potatoes, determination of, Colo. Sta ... 13

Page.

- Stations, Canadian, statistics of ... 245
  - German, statistics of ... 175
  - in the United States—
    - changes in staffs during 1889 ... 118
    - classification of staffs of ... 117
    - lines of work of ... 117
    - number of ... 117
    - publications of ... 118
    - statistics of ... 117
- Statistics, division of, U. S. D. A ... 51, 111, 171, 240, 299, 303
- Steers, feeding experiments with—
  - Ark. Sta ... 9
  - Iowa Sta ... 210
  - Mich. Sta ... 84
  - Tex. Sta ... 152
  - Va. Sta ... 321
- *Stipa spartea*, notes on, U. S. D. A ... 168
- Stock feeding. (See Cattle feeding.)
- Storage of fodder, experiments in, Mo. Sta ... 249
- *Strachia histrionica*, notes on, Ga. Sta ... 27
- Strawberries, analyses, Tenn. Sta ... 317
  - cultivation, Ala. College Sta ... 5
  - leaf blight, N. Y. Cornell Sta ... 281
  - varieties, Ark. Sta ... 188
    - Mass. Hatch Sta ... 225
    - Mich. Sta ... 228
    - Ohio Sta ... 287
    - Tenn. Sta ... 317
    - Tex. Sta ... 319
- Strawberry root louse, notes on, Ohio Sta ... 291
- Streaked cotton-wood leaf beetle—
  - notes on, Minn. Sta ... 232
    - S. Dak. Sta ... 21
- Striped cucumber beetle—
  - notes on, Del. Sta ... 22
    - Iowa Sta ... 45
    - S. Dak. Sta ... 21
  - remedies for, Iowa Sta ... 45
    - Ohio Sta ... 138, 290
- *Strongylus armatus*, Ohio Sta ... 139
- Sugar-beets, field experiments with, Mass. State Sta ... 80
  - in feeding experiments for beef, N. Y. State Sta ... 270
  - varieties, Colo. Sta ... 14
    - Ind. Sta ... 36
    - Mich. Sta ... 87
    - S. Dak. Sta ... 22
- Sugar-cane—
  - diffusion of, La. Sugar Sta ... 73
  - field experiments with, Iowa Sta ... 44
    - La. Sugar Sta ... 63
  - germination of, La. Sugar Sta ... 63
  - plant *vs.* stubble-cane for seed, La. Sugar Sta ... 64
  - suckering, La. Sugar Sta ... 64
  - thickness of planting, La. Sugar Sta ... 64, 65
  - varieties, La. Sugar Sta ... 65
- Sugar-making experiments—
  - at Baldwin, La. (Des Lignes Station), U. S. D. A ... 235
  - Lawrence, Kans., U. S. D. A ... 235
  - Pattersonville, La. (Calumet Plantation), U. S. D. A ... 236

Page.

Sugar making from sorghum, Iowa Sta 44, 212
  U. S. D. A 300
  Jennings process, Iowa Sta. 212
Sulphate of copper for apple powdery mildew, U. S. D. A 170
  black rot of grapes, Del. Sta 195
Sulphur for mildews and insects in greenhouses, Mass. Hatch Sta 83
Superphosphates, analyses of, N. J. Sta 260
  as fertilizers for corn—
    Ill. Sta 33
    Vt. Sta 156
  field experiments with—
    Ala. College Sta 3, 6
    Ind. Sta 39
    N. J. Sta 132
  valuation of, Conn. State Sta 15
Sweet potatoes—
  field experiments with, Ala. College Sta. 3
    N. J. Sta 132
  inquiry concerning rot of, N. J. Sta 265
  preservation of, Ga. Sta 27
Swimmer, undulating back, notes on, Ohio Sta 292
Swine diseases, investigation of, U. S. D. A. 103, 107
Sycamore wood, analysis of, Ga. Sta 26
Sylvanit, analyses of, Conn. State Sta 191
Synchytrium vaccinii, account of, N. J. Sta 263
Systœchus oreas as a locust parasite, Minn. Sta 231
Syrphus fly, notes on, Mich. Sta 226
Systena mitis, notes on, Colo. Sta 12
Tachina flies as locust parasites, Minn. Sta. 232
Tall fescue grass, notes on, Tex. Sta 320
Tankage, analyses of, Conn. State Sta 16
  Mass. State Sta 80
  Tenn. Sta 149
  as a fertilizer in Louisiana, La. State Sta 221
  cattle, as a fertilizer for corn, Ill. Sta 33
  hog, as a fertilizer for corn, Ill. Sta 33
Tannery waste, analyses of, Tenn. Sta 149
Tares, spring, field experiment with, Nebr. Sta 254
Tarnished plant bug, account of, Ark. Sta. 9
Tea, manufacture of, in Japan 247
Teeth of pigs, influence of feeding upon, Minn. Sta 100
Telea polyphemus, notes on, Colo. Sta 12
  Minn. Sta 232
Tenebrioides mauritanica, living in an insecticide, Ind. Sta 41
Tennessee Experiment Station 148, 315
  Station bulletins 148, 315
  University of 148, 315
Teosinte silage, analyses of, Miss. Sta 233
  test of, Mich. Sta 89
    Pa. Sta 143
Teras oxycoccana, notes on, N. J. Sta 134
Tetranychus telarius, remedy for, Mass. Hatch Sta 83
Texas, Agricultural and Mechanical College of 151, 318
  blue-grass, notes on, Fla. Sta 197
    La. State Sta. 69
  Experiment Station 151, 318
  Station bulletins 151, 318
Thermometer, soil, new form of, S. C. Sta 312
Thistle, Canada, root propagation of, N. Y. Cornell Sta 282
  Wisconsin law concerning, Wis. Sta 323
  sow, Wisconsin law concerning, Wis. Sta 324
Thomas slag—
  analyses of, N. J. Sta 260
    Tenn. Sta 149
  as fertilizer for corn, Vt. Sta 156
    cotton, Ala. College Sta. 7
  source of phosphoric acid, N. J. Sta 260
Tilletia laevis (foetens), notes on, Ind. Sta 208
  tritici, notes on, Ind. Sta 208
Tinea pellionella, notes on, Mass. Hatch Sta. 224
  tapetzelli, notes on, Mass. Hatch Sta. 224
Toad-flax, Wisconsin law concerning, Wis. Sta 323
Tobacco stems, analyses of, Conn. State Sta. 15
  as fertilizer for corn, Ky. Sta. 62
  varieties, Md. Sta 75
    Nebr. Sta 123
Tomato industry in New Jersey, N. J. Sta 261
  rot, treatment of, U. S. D. A 169
  worm, notes on, Del. Sta 22
Tomatoes, analyses of, N. J. Sta 262
  fertilizer experiments with, Md. Sta 76
  field experiments with, N. J. Sta. 261
  notes on, N. Y. Cornell Sta 276
  selection of seeds, Mich. Sta 90
  varieties, Ala. College Sta 184
    Md. Sta 76
    Mich. Sta 89
    Nebr. Sta 123
    N. Y. Cornell Sta 277
Tortricid (sp.?), notes on, N. J. Sta 134
Tortrix rosaceana, notes on, Colo. Sta 12
Trees for timber claims, S. Dak. Sta 315
  forest and shade, at Texas Station 320
  experiments with, S. Dak. Sta. 20, 315
  notes on and suggestions for planting, Mich. College Sta 86
  propagation from cuttings, Iowa Sta. 44
Trench system of planting potatoes, Ind. Sta 35
Trifolium incarnatum, notes on, Fla. Sta 197
Trombidium locustarum as a locust parasite, Minn. Sta 231
Trupanea aphidivora, notes on, Colo. Sta 13
Trypeta pomonella, notes on, Me. Sta 73
Tuberculosis, description, history, and distribution, Mass. Hatch Sta 82
Turf, analyses, Mass. State Sta 80
Turnips, analyses of, N. Y. Cornell Sta 136
  field experiments with, Ala. College Sta 3
  varieties, Ala. College Sta 4, 7

Page.

- Turnips, varieties, Nebr. Sta 254
- Typha borer, notes on, Ohio Sta 292
- *Typlocyba albopicta*, notes on, Ohio Sta 291
  - *rosæ*, notes on, Ohio Sta 291
- *Uncinula spiralis*, notes on, Tex. Sta 319
- *Ustilago maydis*, notes on, Nebr. Sta 253
  - *segetum*, notes on, Ind. Sta 209
  - *Zeæ mays* (*maydis*), abnormal structure caused by, U. S. D. A .. 169
- *Vanessa antiopa*, notes on, Colo. Sta 10, 12
  - Minn. Sta 232
  - *milberti*, notes on, Colo. Sta 10
- Varieties of apples, Mich. Sta 229
  - keeping qualities, Mo. Sta 102
  - barley, La. State Sta 69
    - Mich. Sta 87
    - Pa. Sta 143
  - beans, Ala. College Sta 184
    - Iowa Sta 212
    - Mass. Hatch Sta 84
    - Nebr. Sta 254
  - beets, Colo. Sta 14
    - Ind. Sta 36
    - Mich. Sta 87
    - Nebr. Sta 123, 254
    - S. Dak. Sta 22
  - blackberries, Mich. Sta 229
    - Ohio Sta 287
    - Tex. Sta 320
  - buckwheat, Iowa Sta 212
  - cabbages, Minn. Sta 94
    - early, Ohio Sta 293
  - carrots, Mich. Sta 87
    - Nebr. Sta 254
  - cauliflower, Ohio Sta 293
  - cherries, Mich. Sta 229
  - clover, Ill. Sta 34
    - La. State Sta 69
  - corn, Ill. Sta 28
    - Ind. Sta 39
    - La. State Sta 69
    - Nebr. Sta 122, 254
    - North La. Sta 72
    - Pa. Sta 143
    - for silage, Ill. Sta 29
      - Ind. Sta 39
      - Mich. Sta 88
      - Minn. Sta 95
      - N. Y. State Sta 265
      - Ohio Sta 140
  - cotton, Ala. College Sta 7
    - La. State Sta 70
    - Nebr. Sta 123
  - cow-pea, Md. Sta 75
  - cucumbers, Nebr. Sta 122, 254
  - currants, Mich. Sta 229
  - egg-plants, Nebr. Sta 123
  - evergreens, S. Dak. Sta 315
  - forage crops, Pa. Sta 143
    - plants, La. State Sta 69
  - fruits, Mass. Hatch Sta 84
    - (orchard), Md. Sta 76
    - (small), Md. Sta 76
  - gooseberries, Mich. Sta 229

Page.

- Varieties of gooseberries, Ohio Sta 287
  - grapes, Ala. Canebrake Sta 188
    - Ala. College Sta 4
    - Iowa Sta 213
    - Mich. Sta 229
    - Tex. Sta 319
  - grasses, Ill. Sta 34
    - La. State Sta 69
  - kale, Mich. Sta 89
  - mangels, Mich. Sta 87
  - millet, Iowa Sta 212
  - mulberries, Mich. Sta 229
  - musk-melons, Nebr. Sta 254
  - oats, Ark. Sta 189
    - Ill. Sta 203
    - La. State Sta 69
    - Md. Sta 75
    - Mich. Sta 87
    - Nebr. Sta 122, 254
    - Pa. Sta 143
    - S. C. Sta 148
  - okra, Nebr. Sta 254
  - onions, Ind. Sta 35
    - Md. Sta 76
    - Nebr. Sta 123, 254
  - parsley, Nebr. Sta 123
  - parsnips, Nebr. Sta 254
  - peaches, Mich. Sta 229
  - pears, Mich. Sta 229
  - peas, Ind. Sta 35
    - Nebr. Sta 122, 254
  - peppers, Nebr. Sta 123
  - plums, Mich. Sta 229
    - wild, Iowa Sta 42
      - Minn. Sta 94
  - pop-corn, Nebr. Sta 254
  - poplars, Minn. Sta 232
    - Russian, S. Dak. Sta .. 315
  - potatoes, Ala. Canebrake Sta .. 188
    - Ala. College Sta 184
    - Colo. Sta 13
    - Ind. Sta 35
    - Ky. Sta 219
    - Md. Sta 76
    - Mass. Hatch Sta 84
    - Mich. Sta 86, 89
    - Minn. Sta 99
    - Nebr. Sta 122, 254
    - Pa. Sta 143
    - R. I. Sta 297
  - pumpkins, Nebr. Sta 254
  - quinces, Mich. Sta 229
  - radishes, Nebr. Sta 254
  - raspberries, Mich. Sta 229
    - Ohio Sta 287
    - Tex. Sta 320
  - ruta-bagas, Mich. Sta 87
  - salsify, Nebr. Sta 254
  - sorghum, Md. Sta 75
  - strawberries, Ark. Sta 188
    - Mass. Hatch Sta . 225
    - Mich. Sta 229
    - Ohio Sta 287
    - Tenn. Sta 317
    - Tex. Sta 319

Page.

- Varieties of sugar beets, Colo. Sta ... 14
  - Ind. Sta ... 36
  - Mich. Sta ... 87
  - S. Dak. Sta ... 22
  - sweet corn, Ill. Sta ... 33
    - Ind. Sta ... 35
    - Iowa Sta ... 212
    - Nebr. Sta ... 254
  - sweet potatoes, Nebr. Sta ... 254
  - tobacco, Md. Sta ... 75
    - Nebr. Sta ... 123
  - tomatoes, Ala. College Sta ... 184
    - Md. Sta ... 76
    - Mich. Sta ... 89
    - Nebr. Sta ... 123
    - N. Y. Cornell Sta ... 277
  - trees, S. Dak. Sta ... 315
  - turnips, Ala. College Sta ... 4, 7
    - Nebr. Sta ... 254
  - vegetables, Ind. Sta ... 35
    - Nebr. Sta ... 123
  - water-melons, Nebr. Sta ... 254
  - wheat, Ark. Sta ... 188
    - Ind. Sta ... 206
    - Iowa Sta ... 210
    - Kan. Sta ... 214
    - Ky. Sta ... 218
    - La. State Sta ... 69
    - Nebr. Sta ... 122, 254
    - Ohio Sta ... 289
    - Pa. Sta ... 143
    - S. C. Sta ... 148
  - willows, Russian, Minn. Sta ... 232
- Variety tests at Pennsylvania Station ... 295
- *Vedalia cardinalis*, as an enemy of fluted scale, U. S. D. A ... 301
- Vegetable pathology, section of, bulletins, U. S. D. A ... 169
  - physiology, department of, at Mass. State Sta ... 81
- Vegetables, field experiments with, Ind. Sta ... 35
  - Japanese, varieties, Ind. Sta ... 36
  - tests of seeds of, Del. Sta ... 23
  - varieties, Ind. Sta ... 35
    - Nebr. Sta ... 123, 254
- Vermont State Experiment Station ... 155, 320
  - Station bulletins ... 155, 320
  - University of ... 155, 320
- Vetches, field experiments with, Nebr. Sta ... 122, 254
  - in feeding experiments, Mass. State Sta ... 77
  - trial of, Mich. Sta ... 89
- *Vicia sativa*, field experiment with, Nebr. Sta ... 254
  - *velosa*, trial of, Mich. Sta ... 89
- Vine worm, notes on, N. J. Sta ... 131
- Vineyard of Iowa State College, Iowa Sta ... 213
  - North Louisiana Station ... 71
  - Texas Station ... 319
- Virginia Agricultural and Mechanical College ... 158, 321
  - Experiment Station ... 158, 321
  - Station bulletins ... 158, 321
- Vitriol, blue, as a fungicide for black smut, Ind. Sta ... 209

Page.

- Walnut, English, test of, Mich. Sta ... 229
  - trees, notes on, S. Dak. Sta ... 20, 315
- Water, analyses of, Colo. Sta ... 191
  - Fla. Sta ... 197
  - La. State Sta ... 221
  - determination in air-dried fodders, N. Y. Cornell Sta ... 135
- Water-bug, lesser, notes on, Ohio Sta ... 292
- Water-melons, varieties, Nebr. Sta ... 254
- Web-worm, garden, notes on, Colo. Sta ... 10, 12
  - sod, notes on, Iowa Sta ... 15
- Weeds, methods of eradicating, Wis. Sta ... 323
  - plan for investigation of, N. J. Sta. ... 130
  - seeds, mixed with grass seeds, Del. Sta ... 24
  - vitality of seeds, N. Y. Cornell Sta. ... 282
  - Wisconsin law regarding, Wis. Sta ... 323
- West Virginia Experiment Station ... 160, 322
  - Station bulletins ... 160, 322
  - University ... 160, 322
- Wheat, analyses of, Minn. Sta ... 99, 100
  - aphis, enemies of, Mich. Sta ... 226
  - bearded *vs.* smooth, Ohio Sta ... 289
  - bran, analyses of, Conn. State Sta ... 15
    - N. Y. Cornell Sta ... 282
    - in feeding experiments, Mass. State Sta ... 77
  - by-products, analyses of, Minn. Sta. ... 230
    - explanations of terms, Minn. Sta ... 230
  - damaged, experiments in germination and growth, Minn. Sta ... 95
  - distribution of seeds of, Ohio Sta ... 290
  - field experiments with—
    - Ala. Canebrake Sta ... 187
    - Ark. Sta ... 188
    - Ind. Sta ... 206
    - Kan. Sta ... 214
    - Ohio Sta ... 288
    - S. C. Sta ... 116, 148
    - S. Dak. Sta ... 19
    - Va. Sta ... 158
  - frosted and rusted, Minn. Sta ... 91, 99, 100
  - fungi causing rust on, Minn. Sta ... 94
  - germination of frosted, S. Dak. Sta. ... 19
  - grass, wild, field experiments with, Nebr. Sta ... 121
  - listing of, Kan. Sta ... 215
  - methods of cultivation, Kan. Sta ... 214
    - Ohio Sta ... 288
    - seeding, Ky. Sta ... 218
      - Ohio Sta ... 288
  - of Iowa Station, notes on, Iowa Sta. ... 209
  - pasturing of, Kan. Sta ... 214
  - plant, changes during freezing, Minn. Sta ... 91
  - red *vs.* white, Ohio Sta ... 289
  - rust, notes on, Ind. Sta ... 204
    - N. C. Sta ... 138
  - smut of, Ind. Sta ... 207
    - Nebr. Sta ... 252
  - suggestions to growers, Ind. Sta ... 207
  - varieties, Ark. Sta ... 188
    - Ind. Sta ... 206
    - Kan. Sta ... 214

Page.

- Wheat, varieties, Ky. Sta ... 218
  - La. State Sta ... 69
  - Nebr. Sta ... 122, 254
  - Ohio Sta ... 289
  - Pa. Sta ... 143
  - S. C. Sta ... 148
- Willow saw-fly, notes on, Minn. Sta ... 232
- Willows, directions for growing, Minn. Sta ... 232
  - insects affecting, Minn. Sta ... 232
  - Russian, growth from hard wood cuttings, Minn. Sta ... 93
    - varieties, Minn. Sta ... 232
- Wind-breaks—
  - relations of, to fruit growers, N. Y. Cornell Sta ... 276
  - varieties of trees for, N. Y. Cornell Sta ... 276
    - Tex. Sta ... 320
- Wire-worms, notes on, Iowa Sta ... 45
- Wisconsin, Agricultural Experiment Station of University of ... 161, 323
  - Station bulletins ... 161, 323
  - University of ... 161, 323
- Wood seasoning, experiments in, U. S. D. A. 110
- Woods of Alabama, notes on, Ala. College Sta ... 4
  - native, analysis of, Ga. Sta ... 26, 27
- Wool waste, analysis and valuation of, Conn. State Sta ... 17
  - Mass. State Sta ... 80
- *Xanthium strumarium*, Wisconsin law concerning, Wis. Sta ... 323
- Yellow-spotted willow-slug, notes on, S. Dak. Sta ... 21
- *Zaitha fluminea*, notes on, Ohio Sta ... 292
- Zebra cabbage worm, notes on, S. Dak. Sta ... 21

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